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ENGLISH LITERATURE.—KING'S COLLEGE, LONDON.—Professor the Rev. F. MAURICE, M.A., will commence his Course of Lectures on ENGLISH LITERATURE, at the College, by an INTRODUCTORY LECTURE, on TUESDAY NEXT, the 13th instant, at Two o'clock precisely in the afternoon.—Any gentleman, presenting his card, will be admitted to this Lecture.

9th Oct. 1840. J. LONSDALE, Principal.

GEOLOGICAL MINERALOGY.—KING'S COLLEGE, LONDON.—Mr. J. TENNANT, F.G.S., will commence a Course of Lectures on MINERALOGY, on WEDNESDAY, October 14, at 9 o'clock A.M. The instruction will consist of a minute description of all the substances entering into the composition of Rocks, and of those Minerals which are also used in the Arts: illustrated by characteristic Specimens, and Diagrams of their principal crystalline forms, &c.—Further particulars may be obtained at the Secretary's Office, King's College; or of Mr. Tennant, Mineralogist, 149, Strand.

GOVERNESS AGENCY, 30, Soho-square.—Mrs. HINTON respectfully states that she is just returned from Paris, and having visited the principal Schools, would be happy to forward prospectuses and particulars of Scholastic Establishments in England and France. Postage, the only expense, must be free. Schools transferred. Mrs. H. has on her list Foreign and English Governesses, properly qualified for Families or Schools, and situations for Governesses in both countries.

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50	3 2 6	3 19 0	5 12 0

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40	1 16 10	2 7 0	3 8 2
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	Total duty paid, 1839.	Sum insured on Farming Stock, exempt.
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Phœnix	130,151 0 1	4,748,495
Royal Exchange	68,876 17 9	4,643,589
Norwich Union	66,874 14 10	9,459,178
County	45,100 7 5	6,482,414
Guardian	34,918 7 9	562,295
Globe	33,322 3 4	1,058,852
West of England	32,424 10 0	898,369
Imperial	28,222 6 8	319,240
Alliance	25,513 8 11	539,817
Atlas	25,122 2 4	905,157
SCOTTISH UNION*	20,502 5 10	837,662
Westminster	18,663 1 5	26,850
British	18,349 10 0	648,774
Union	18,212 10 1	235,567
London	13,359 13 2	150,807
York and London	11,584 15 4	609,230
Hand-in-Hand	10,996 2 2	—
Licensed Victuallers	5,210 9 10	—
Protestant Dissenters	3,840 15 8	74,485
Independent and West Middlesex	2,073 6 7	76,700
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LONDON, SATURDAY, OCTOBER 10, 1840.

REVIEWS

Journal of a Residence in Circassia during the years 1837, 8, and 9. By J. S. Bell. 2 vols. Moxon.

A Year among the Circassians. By J. A. Longworth. 2 vols. Colburn.

THE heroic struggle which the Circassians have for so many years carried on against the giant power of Russia, has awakened a generous enthusiasm in their favour in the heart of all Europe—an enthusiasm however which tends in no degree to blind persons of common sense to the certain issue of the contest, or to the masquerading folly of those who run up and down the country denouncing Russia, and decrying the foreign policy of England. Fortunately there is little of novelty in relation to these vexed questions in either of the works before us: the views of Mr. Bell are well known, and Mr. Longworth and Mr. Bell are *alter et idem*—the same with a difference. These gentlemen entered the country with the same views, were associated together in most of their adventures, and, oddly enough, the work of each concludes with a sort of song of triumph on successes acquired since they took leave of their patriot friends. Politically, then, neither work is of much value: but so little is known of the civil and social condition of the Circassians, that both are welcome as containing the observations of intelligent persons who resided some time in the country,—a country which, according to Mr. Longworth's report, only five Europeans have visited, excepting the army of the invaders: and not the less welcome from the hearty partisanship which pervades them, and which sometimes misleads Mr. Bell, and makes him sadly credulous as to the misdeeds of adversaries, general and individual, and tempts him to placard the Russians with those opprobrious names and epithets which tend only to shake our faith in his arguments.

To attempt even an outline of either Mr. Longworth's or Mr. Bell's personal narrative is out of the question. It will be enough to say, that on their arrival they were, perforce, thrust into the unexpected position of privy councillors and provisional governors, became, in consequence, objects of suspicion to many persons, and appear to have been more than once detained in an honourable captivity by their hosts; hence, though much was displayed, much, we suspect, was veiled from them. From their united journals, however, a picture may be drawn of the habits and manners of the brave people among whom they sojourned—more complete, we are disposed to believe, than is to be met with elsewhere. We will therefore proceed to offer some of the marking features of this picture; apprising the reader that we shall quote alternately from Mr. Bell and Mr. Longworth, as seems most convenient. There is, indeed, no discrepancy between them, except in the matter of orthography, in which the former, as was likely, appears to be the more native of the two.

In general, the Circassian has many family features common to the Paladins of Chivalric Europe—there is a touch, too, of the Picaroon in his character; but that was to be found in the knight of old, as the reader will see, in that genuine record of a youth's education, the Mabinogion, 'Pereduc, son of Evrawc,' (*Athen.* No. 620.) While their personal gallantry is undoubted, their hospitality emulates that of the patriarchal ages, and their munificence almost literally fulfils the Orientalism in which the half of a kingdom "was promised to him whom the host delighted to honour,"—they do not hesitate to "convey," we are told, when not in their own district, nor to appropriate loans, nor to lay traps for presents with a cunning at variance with their nobler attributes:—the following anecdotes show both sides of the tapestry. Mr. Longworth shall begin, with a story of his host:

"In person he was tall, dark, and grave as a Castilian, a man of few words, but whose sad and serious countenance interested me greatly. On the first day of my arrival he kept himself most respectfully aloof, and it was only by dint of much persuasion he could be prevailed upon to sit down. But on the next day, having established himself in the suburbs of my good graces, he ventured on a nearer *reconnaissance*, and gradually edging himself towards me, squatted at length close to my couch. Here, though he continued to say nothing, he looked a great deal, and I sympathized with what I took to be his patriotic sufferings. But when, on the third day, he grasped my hand, and sighed repeatedly, I could almost have wept for one whose heart I thought was inwardly bleeding over the wrongs of his country; in short, I felt I could do anything, or make any sacrifice, for so good a man. The reader may judge, therefore, I felt rather surprised and disconcerted when, through the intervention of the Hadji, he all at once begged as a particular favour that I would give him my telescope, the possession of which, he said, would make his hamlet the happiest in Circassia. The telescope was a large and valuable one; yet though I begun to have my misgivings of the man, I desired the Hadji to tell him that he should have it when I left the country, but that in the meantime I had occasion for it myself in my travels. In answer to this, he suggested, that as he intended to accompany me in all my peregrinations, he would carry it for me. I consented to this arrangement, and he accordingly attended me on my route for three days, at the end of which time, he begged I would give him a pistol, which being flatly refused to him, he immediately disappeared with the telescope."

A more absurd artifice was resorted to, in the case of Mr. Knight, who joined for awhile the Circassian cause, and who passes in these volumes under the mask of his adopted name, Nadir Bey, although distinctly named by Mr. Longworth in his preface:—

"Nadir soon made his way with the Deli-Kans, among whom he was well qualified to shine, by his proficiency in field sports. A crack shot with the rifle, he more than once bore away the prize at their shooting-matches, and though harder pushed at their races, at which their skill in dodging and winding on horseback seemed to give them the advantage, he had therein also resources of his own, and showed he had not ridden steeple-chases for nothing. I shall not forget their surprise and glee, when, in his first essay, being closely pressed by his pursuers, who thought they had driven him into a corner, he left them suddenly at fault by clearing the high fence before him. Leaping, which was before only practised from necessity, became, after Nadir had set the fashion, quite in vogue as an amusement; and for some time afterwards the Deli-Kans, we could see, were putting their nags at the fences all over Natukoitch. This superiority, instead of exciting envy, was admired by all in a manly spirit of fair play; indeed, the praises that were bestowed on it sounded sometimes rather suspiciously from their extravagance; and in the number of those who applied to be retained among his immediate satellites, were some whose motives might, perhaps, be called in question. One man, as was duly reported to him by his servant Kutchuk, declared there was an indescribable something in his face which had completely fascinated him; and, in short, nothing would serve his turn but to bind himself to him by the solemn vow of friendship and fidelity, which, like the Deli-Kans of the heroic ages, such as Damon and Pythias, &c., those of Circassia are to this day accustomed under such circumstances to exchange with each other. Nadir, though he saw nothing in the round unmeaning face and snub nose of this romantic swain, who was, moreover, turned of fifty, to produce a corresponding sensation on his part, consented nevertheless, out of curiosity, to humour him. Accordingly, at night, when all other visitors had retired, for it seemed the ceremony demanded secresy, the fellow was introduced into the guest-house, and, after a great deal of amusing mummery and grimace, he gave him, by way of finale, as we thought, an affectionate squeeze of the hand: but Kutchuk, who acted as interpreter, and took a somewhat suspicious degree of interest in the ceremony, now intimated that, to ratify it, it was incumbent on him, who was the wealthier of the two, to make a suitable donation to the other."

Mr. Bell seems to have been expected to "pay his footing" after a like fashion. But, lest we appear unfairly to dwell on anecdotes of this character, let us exhibit a case or two in which the reciprocity (as the footman said on his trial) "is all on the other side." Mr. Bell and Mr. Longworth were on a visit to a native chief Tûghûz (or "The Wolf"):—

"The greater portion of next morning was spent under our canopy in political conferences with the persons of note assembled; and then there was displayed (against us) on the grass an array of thirty-six dinner-tables, which, in such hot sun-shine as prevailed at the time, looked more like an attack upon our comfort than a contribution to it. Exhausted by the heat, talking and eating, I had retired a short time to the comparative quiet and shade of our cottage, when I was called forth to resume my place in the tent; and presently I saw advancing from the houses of our host's family, across a little brook, a party of people with his lively white charger in the midst. An excellent coat of chain mail was laid by one of the party at my feet; a vista in the crowd showed Mr. L—— the charger which was intended for him, and to my servant was given a sabre, the scabbard of which was embroidered with silver lace. These presentations were accompanied by a short speech from Tûghûz expressive of his want of means wherefrom to give things more suited to our deserts, and of his hope that we would be contented with such as he could give. We replied in suitable terms to such generosity, and added, that having accepted his presents as a proof of his attachment and respect, we must beg of him to allow us to return the horse, adding that we should consider the coat of mail as presented to us jointly. This seemed to us the more necessary, that this brave chief is kept constantly in want by his extreme munificence; for although he frequently receives large presents from his wealthy relatives in the interior, he gives them away (as he did with a present we gave him) almost as soon as he gets them. Thus it comes that he who a short time ago had thirty horses and four coats of mail, has now scarcely a horse but the white charger, and no other coat of mail than the one I have spoken of."

A few pages further we find Prince Pshûgûï insisting on changing coats with Mr. Bell, telling the latter that his was woven and made up by his wife, and "profusely braided with silver lace," a manufacture much in vogue among the Circassian maidens. Mr. Longworth gives the same account of the visit to Tûghûz (spelt by him *Tongouse*). A portrait, by the way, of this gallant chief will not be amiss, as a specimen of the Circassian hero:—

"In short, Tchorook Oglu Tongouse, or 'the Wolf,' was a good model of the Circassian *preux chevalier*, altogether *sans peur*, if not *sans reproche*. Whatever enterprise was in hand, were it foray, onslaught, or ambuscade, he for one might be depended upon; if wrongs were to be redressed—individual, provincial, or national—Tongouse was invariably the champion. When certain of the Caucasian provinces had made separate terms with Russia, he was the first, by his successful inroads, to make them repent of their apostacy. His name had spread even as far as the Ingouches, whose children 'the Wolf' had more than once carried off from them. Such celebrity in a man yet scarcely in his prime had produced its natural effects on the ladies of the Caucasus, and he had more claims on his heart than even the Mahomedan dispensation, indulgent as it is, could allow him to do justice to. The consequence was, that his decided disposition to please led him into many scrapes, and the fines he had drawn on himself and

his tribe would, if they had all been duly paid, have stocked half the estates in Natukvitch with horned cattle. The only remedy for these disorders was, that he should take to himself a wife or two; and as the ample patrimony he inherited no longer sufficed for it, the purchase money was cheerfully, and from motives of economy, contributed by his tribe. He accordingly married two wives. The first, the most beautiful, and the second, the most accomplished woman in Circassia. His success in the courtship of the former created no surprise. Beauty and bravery have mutual attractions all the world over; the one being held to be the legitimate meed of the other. But that Guavcha, the discreet and stately daughter of Indar Oglu, should throw herself away on such a scapegrace as Tongouse did excite the special wonder and the no small indignation of her tribe and family. The hand of a princess possessing the manual dexterity of Guavcha—unrivalled in the works of the loom and needle—had been eagerly sought by the wisest and the wealthiest nobles of the land. But wealth and wisdom seemed to make little impression on her; and the fastidious princess, conscious, perhaps, that her charms were of a durable nature, was in no haste to make a selection. But her mind was at length made up, and that somewhat suddenly, being one fine morning nowhere to be found in the paternal domains of Pchat, having been transferred by moonlight on the crupper of his steed to the harem of Tongouse, at Tedjaguz. To portray the person and equipment of this barbarous Lovelace, (a very appropriate name by the way for a Circassian gallant, who is garnished all over with silver trimmings,) would entirely baffle my feeble powers of description. As far as the habiliments are concerned, it would be impossible to convey any definite idea, for the simple reason that they were never for two days together the same—in casque, mail, and gloves of steel, gallantly armed, at one time—at another, he was undefended, not only against the enemy, but even against the weather, by a threadbare tunic; now, girt with bow and quiver, and now bristling with rifle, dagger, and pistol. At one moment clad in a gay silk anteri, and a coat resplendent with the silver lace aforesaid—the next he was covered with rags. To-day he would meet you on a superb white charger richly caparisoned—to-morrow you would see him worse mounted than the Knight of the Rueful Countenance himself. Now all these transmutations, which a stranger might unjustly charge to caprice, were in the eyes of the admiring Dely Canns but so many proofs of a brave and liberal spirit. Accoutrements, arms, horses, and slaves themselves, are things which such a hero is proud to part with—for it is presumed to be a proof that his valour can easily replace them. But though in his outward man the Proteus I have attempted to delineate, there were qualities about Tongouse which he could not change with his coat. For example—however he might be dressed, I never knew him to stand less than six feet three inches in his shoes; and whether in shirt of steel or of Bez, the formidable play of his muscles was the same. Indeed, with regard to the latter, being much addicted to frolics and practical jokes, such as flooring, unhorsing, and riding down his companions, the vigour they exhibited was by many of them deemed even superfluous; whence it was said that the only fit playfellow for Tongouse was his horse; a saying, in a great measure, justified by the terms on which they lived, taking liberties with each other which none but the most intimate friends would venture upon."

Still more eminent than this Lochinvar of Circassia is Hadji Guz Beg—if less general in his wooing, even fiercer as a warrior; indeed, for his fierceness and recklessness, hardly "accounted a safe or a prudent leader." Of course, the volumes before us are filled with details of his gallant prowess:—

"Innumerable instances of individual bravery and heroism might be here collected," says Mr. Bell; "of these there is no want; although there is no appearance of a principle of combination by which greater and more permanent results might be produced. I should not give you the following instance, but that the greater part of the transaction was witnessed by several people who happened to be on the banks of the Kûban at the time; and that is an example of a desperate love of liberty, general among Circassians, of whom very few ever allow themselves to be made prisoners. A young man of Shapsuk, after killing or wounding several Russians in a late affair across the Kûban, was made prisoner and carried to Yekaterinodar. There he was questioned about, and frankly told, all the acts of hostility he had been of late concerned in, pointing out two of the soldiers he had wounded. He was threatened with death, fettered and thrown into a dungeon. But during the night he contrived to free himself from his irons, and to dig a hole through his prison wall, by which he got into the enclosure. This was surrounded by a wall and chevaux-de-frise, which he surmounted by grasping the points of iron in his hands, and thus making a footing, from which he leaped down upon the outer ground. Here he was encountered by two sentries; but snatching up a billet of wood that fortunately lay at hand, he felled one of the soldiers to the ground with it, escaped from the other, and ran towards the Kûban. On the way, three Cossacks attacked him, whom he kept at bay with his billet until he reached the river and plunged into it. His trials were not yet at an end, for some soldiers put off in a small boat in pursuit of him, nor would his diving have, in all probability, saved him, had he not succeeded in upsetting the boat. At length he reached the shore, but finding himself in Psadûg—the people of which have made terms with the Russians—he was so fearful they would capture and deliver him up, that he set off in the state of nakedness, to which he had been reduced in his scuffles, towards his home, which he succeeded in reaching in safety."

While, however, the achievements and personal courage of the Circassian warriors are worthy of a native Homer to sing them, (nor are minstrels wanting, according to the testimony of our travellers,) and are borne out, as we have seen, by that other attribute of knighthood, gallantry to the sex—in return for which, like the high-born beauties of old, the women visit the warriors when wounded—bravery is accompanied by another of the observances of the rough old times—great respect to age. "On the first appearance of Indar Oglou at the council," says Mr. Longworth, though he was considered there as an alien and an intruder,—"conformably with the respect that is invariably shown to age, the whole assembly got up and saluted him." Mr. Bell, too, has more than one anecdote illustrative of the same trait of national manners:—

"Achamish Hadji Ali, a very fine-looking old man, arrived from the south, a little ago, to pay his respects to me. The attendants, as usual, ran and relieved him of his arms. When he entered, I rose and shook hands with him, and then motioning for him to be seated on the divan, on the opposite side of the fire, showed him the example by seating myself. I thought, from his lack of silver trimming, that he might not be of the nobility, and that this was the cause of his backwardness in accepting my offer; or, that, as a stranger, custom entitled me to be first seated. But herein I committed a breach of manners; for although a greater stranger here than the old man, and although ranked in the estimation of the people above their highest nobles, it was not sufficient that I showed him a seat; I ought to have remained standing until he accepted it, as old men, of whatever rank, have here always this respect paid them."

Our authors are agreed as to the general good-breeding, as well as the unmeasured hospitality of the Circassians.

We have already, in the case of Nadir Beg and his would-be Pylades, adverted to the romantic brotherhood in arms encouraged among the young men: but the spirit of association is carried to lengths far beyond this, as the following extracts will show:—

"The Circassian word for the societies or fraternities is 'tleûsh,' which signifies also 'seeds.' The tradition with regard to them is, that the members of each all sprang from the same stock or ancestry; and thus they may be considered as so many septs or clans, with this peculiarity—that, like seeds, all are considered equal. These cousins-german, or members of the same fraternity, are not only themselves interdicted from intermarrying, but their serfs too must wed with the serfs of another fraternity; and where, as is generally the case, many fraternities enter into one general bond, this law, in regard to marriage, must be observed by all. All who are thus bound together have the privilege of visiting the family-houses of each other on the footing of brothers."—"Throughout all Circassia, I am told, there are fraternities and extensive associations of these smaller brotherhoods. Their chief peculiarities are, that the members are bound mutually to protect each other, and assist in paying the fine of individuals who may commit manslaughter, or other crimes: but this is only done on the first, or first and second occasions; if the offence is again repeated, the society takes the punishment of the individual upon itself, and sometimes inflicts death. All the brotherhood are also bound to aid any member who may fall into reduced circumstances. * * No brother may marry the daughter of one of his brother associates, and the fraternity sees specially that no brother disgrace himself by a marriage beneath his grade in the country, whatever it may be; for there are fraternities of nobles of different grades, and of freemen, including *their serfs also*. Each fraternity has its appropriate name."—"I have learned some other regulations of the fraternities; viz. that upon the death of any member, his wife being the property of the fraternity, as having been purchased by one of its members, is given in marriage without payment, to another member, upon the condition of his supporting her children if she have any; but if she be too old to be married again, the society is bound to support her. If she get permission to marry into another fraternity, she must part with her children, who must remain in their father's."

The following is an illustrative anecdote of Jedwood justice, executed at a dance,—the description of which we shall give entire:—

"Yesterday, in compliance with a ten days' invitation, we went to attend the marriage, or rather betrothment-festivities of the son of a neighbouring wealthy merchant. We went over, ladies and all (but not together), between nine and ten o'clock, by which time a very large company was already assembled, and a wide densely-packed circle of males and females was busily engaged in dancing. But, in this amusement, I am sorry to say, the Circassians, so far as I have yet seen, have not displayed any elegance of invention. The circle was composed of men and girls alternately: each man placed his arms under those of the girls who adjoined him, and interlaced his fingers with theirs. The master of ceremonies—with a long flat baton in his hand to keep order withal—the musicians and other individuals, some of whom sung a sort of bass accompaniment to the instrumental music, were placed in the midst of the circle. The instruments were the three-fingered pipe, and two-stringed violin I have formerly described. As for the dancing, it consisted merely of a swinging of the body backward and forward (the entire circle moving round slowly at the same time), as if it were preparatory to an occasional springing gently upwards on the toes. Sometimes only a portion of the circle moved thus upwards, communicating the motion to the rest in vermicular undulations; sometimes the whole did so simultaneously; and ever and anon, as some slenderer damsel became oppressed with the squeezing, heat and dust, and retired to the adjoining group of females, others were brought forward by their mothers to supply the vacancies; and, in the selection of these vacancies, no doubt a good deal of maternal prudence and *foresight* was exerted, as I thought I saw. This figure was danced during all the time we remained, and would be continued till sunset, having as strong a hold, it would seem, on the fancies of the Circassian young folks, as the 'first quadrille' had, or has on those of England. But even with this peaceful pastime, something warlike must be mingled, to stimulate the Circassian fancy; thus pistols every few minutes were fired over the circle of dancers, and it was incessantly threatened with a breach being made in it, by an onset of horsemen (some of the chiefs took part in this, but none in the dancing), who were repelled by a body of youths on foot, screaming and striking the horses with branches of trees to frighten

them. But nothing of all this appeared to have the least effect upon the nerves of the ladies, either young or old; and even a much more alarming, though, I fear, not a very unusual incident I am about to mention, produced none of those vociferous and unequivocal evidences of fear which slight causes frequently elicit from the females of the West.—While gazing from an eminence upon the dancers, Mr. L— and I saw, amid a little throng of lookers-on, a long white pole suddenly elevated and brought down with such good or rather bad will on the head of one of the party, that it felled him to the ground instantaneously. The dance was broken up by the men in it rushing out to surround the aggressor, when a loud and violent altercation ensued. Meantime the females retired, and we descended to see the sufferer, a tall young man, who was led under a tree with his head bleeding copiously. But the blow had fortunately taken place on the side of his head, where the sheep's wool of their caps forms a good protection; otherwise the skull must have been fractured, unless those of Circassia be much harder than ours. The young man did not utter a word of complaint; amid the conflicting statement given us by others, the only explanation we could then get was, that he was a relative of Tshûrûk-okû Tûghûz, and had been present when one of his serfs shot a relative of the present aggressor, who appeared the more to blame, as the master of the festival had, at its commencement, made proclamation (according to custom) requiring that all present should defer their feuds, if they had any. We accordingly expressed strongly our disgust at the conduct of the assailant, and our determination to quit the ground unless he were sent away. He had the discretion not to wait for this. By and by the females were brought back from some adjoining houses they had retired to, and the festivities proceeded without further interruption, unless the serving of a plentiful dinner can be called such. To us the scene it afforded was none of the least interesting, as there were present between three and four hundred people, divided, according to their grades and fancies, into some dozen separate groups, to serve whom three or four men mounted and as many on foot, flying about with tables, trenchers, &c., in their hands, were kept busily employed. The ladies dined by themselves in the houses; and their frequent slow and stately procession to and from these houses, formed to my eye by far the most graceful part of their performances. Horse-racing and mark-firing were other portions of the entertainment. We retired soon after the repast, having first sent a present to the betrothed lady. Another entertainment will be given when the marriage takes place.—Upon subsequent inquiry as to the cause of the assault we had witnessed, it turned out that the young man who had suffered by it (who has since been here and appears none the worse for the blow) was present, and assisting along with thirty or forty other members of two fraternities, in putting to death a man who had been found an incorrigible thief; and that his relative thought it incumbent on him to avenge the death, because the trial and sentencing of the culprit had not been conducted with the usual formalities, the heads or presidents of the societies not having been present. The prescribed forms are that each man should be tried (as I shall hereafter show) by the elders of the two fraternities concerned, and be punished by his own society; that smaller fines should be inflicted for the first and second theft, and one of 200 oxen or death for the third; and if death be inflicted by others than one's own fraternity, 200 oxen fall to be paid by those concerned in it to the fraternity and family of the person executed. The young man was generally blamed for having presented himself at the festival, while the feud necessarily arising out of the irregular proceedings of his fraternity was uncompounded; because he might have expected that some of the opposite party would be present also."

When to the above traits are added great physical strength, and a country made by nature impregnable, it will be seen that Russia has no contemptible adversary in this brave handful of men. In another article, we will take a glimpse at the position of the gentler sex in Circassia, and at those habits and ceremonies of daily life which are always welcome to the observer.

The Political and Anecdotical History of the Prisons of the Seine—[*Histoire Politique, &c.*] By Barthélemy Maurice. Paris, Guillaumin.

THERE are scarcely any of the public institutions which are common to nations, that might not furnish, if we had their unmutilated records before us, reasonable indications as to the state of civilization and the progress of morals. The great principles which are of universal application to associated bodies are inevitably modified by the character and condition of the particular association to which they belong; and upon each and all of them, if they have "writ their annals true," events have left behind indelible traces of their character. Of these great social and historical Daguerréotypes, the prison, with its accessories, is not the least faithful and significant. While all the leading incidents of a people's history have had their shadows reflected from its registers—while all the national storms have beaten against its walls, and echoed through its dungeons—so, in more peaceful times, it is a most delicate instrument for testing the deleterious elements that mingle in the composition of the body politic. In its alembic society deposits a residuum, which furnishes to the moral analyst a means whereby he may detect the poisons that circulate through the corporate veins. The prison, averred, and truly, to be, like the gallows, an evidence of civilization, is, nevertheless, the representative of those destructive principles by which civilization is perpetually threatened and impeded. Every imprisonment is, necessarily, the record of a crime,—on the part either of the prisoner or his gaoler, of society or the individual; and the crimes which are registered, as well as the condition of the register itself, are, therefore, alike significant witnesses,—the one to the morality, and the other to the civil freedom of a people. To this finer part of the philosophy of the subject, the volume before us furnishes no contribution. Some attempt is made, from the statistics of Clichy, to deduce a very imperfect argument as to the morality and political economy of imprisonment for debt; and this is the only portion of the book which meddles with the *morale* of the subject;—but that question has been far more elaborately argued amongst ourselves, and upon data infinitely more complete; and we have arrived at a result which renders it unnecessary that we should repeat any of the author's reasonings. One or two detached historical inquiries are, however, conducted with better success, by means of the tests which the prison records furnish, though the absolute term *history*, as applied to the accounts given of any one of these prisons, is not warranted by the completeness of the materials.

In enumerating the varied lessons and materials which the prison, at all times, furnishes to the many modes of intellectual action or inquiry, it is needless to insist here on that which is the most obvious quality of its documents—their romantic and picturesque character. This necessarily arises from its records being, for the most part, each the index to a complete drama—each a mnemonic of the passions, in their hour of action. It is the exceptional character of the events that cause the separation of the individual from society; and in their exceptional quality we have the first element of the picturesque. For this reason, the "secrets of the prison-house" will always furnish popular and attractive reading, even where it is merely anecdotical, and not presented with a view to any moral or philosophical demonstration. The book before us, with the exception to which we have alluded, is principally interesting in this point of view; and, in borrowing from its contents what may be most entertaining to our readers, we shall therefore, at the same time, present them with that which is its most characteristic feature.

Previously to the year 1834, prisoners for debt were confined in a portion of the ancient convent, and modern prison, of Sainte-Pélagie: and, though this portion of its records, from their civil, and less exceptional character, furnish fewer dramatic incidents than are to be gathered from the records of criminal gaols, yet the eye cannot run over their pages, without getting many a hint at strange vicissitudes and mournful histories. The annals of even a debtors' prison, while they register much of human sorrow, register, also, much of human guilt; and if the sorrow and the guilt be less apparent on the record, from their less direct connexion with the immediate fact of the imprisonment itself, yet the cold formula of the commitment is, in general, a hieroglyphic which they who are skilled in the mournful lore that prisons and courts of justice teach, and have read much of the history of the human heart in those dreary pages, can interpret but too truly. The two great events which have cast their broad and general shadow on the book of Sainte-Pélagie (its Clichy volume, we mean,) are the revolution of 1830, and the cholera of 1832. At the closing of the gates on the night of the 27th of July, in the former of these years, 256 debtors were present within its walls. On the 28th, the sound of the revolution reached the gaol; and the prisoners from the criminal side having broken out through the debtors' quarter, 168 of the latter left the prison on that day, and 63 more on the 29th: 26 civil prisoners had the apathy to remain calmly in their cells, without once condescending, though the doors stood wide open, to look out upon the social earthquake that was exhibiting its phenomena everywhere around them. Many of the liberated debtors took part in the national fight, some earning ribbons, and some graves; 19 voluntarily returned to their captivity when the popular triumph was complete; 116 were ultimately recovered by the authorities; and 96 (some of whom, and how many, probably was never known, filled the graves in question,) were finally lost to the law. In 1832, the appearance of the cholera within the walls of Sainte-Pélagie spread terror amongst the unhappy prisoners, aroused all the better feelings of the creditors, and once more emptied the debtors' side. About a third of the whole, who had the immediate means, were at once removed into various *Maisons de Santé;* and governor, gaolers, and creditors themselves, went about, in a noble rivalry, soliciting subscriptions for the removal of the rest. It is pleasant to find the annals of a prison yielding a page like this; and more than commonly painful to see the generous record darkened by a stain from which the heart shrinks, if the nerves do not, more sensitively than even from crime. Twenty francs per month, which the subscription yielded, was inadequate to maintain each prisoner in the *Maison de Santé* to which he was consigned; and, in a noble continuation of the same spirit that had unlocked the doors of Sainte-Pélagie, they were allowed to go whither they would, returning to their several houses of detention only on the day and at the hour when the gaoler was to be there with their subsistence-money. "It was a pious fiction," says the author, "of which magistrates and creditors alike suffered themselves to appear the dupes." One would willingly have believed that all men must have held sacred a parole like this—that not one would have availed himself of the active humanity which had saved his life, to effect his escape and leave his benefactors responsible: yet twelve never returned; and a sickness comes over the spirit, as we read of M.

Bernier, a physician, from whose house a scoundrel of the name of Leroux (an ex-notary, detained for debts amounting to between 3 and 400,000 francs) fled into Belgium, who was prosecuted by the creditors, on his generous guarantee, ruined in his fortunes, and himself flung into that prison which had no dungeon dark enough for the villain whose victim he had been made.

The debtors' registers of Sainte-Pélagie contain many of the most notorious and illustrious names of France; but where the notoriety does not attach to the imprisonment itself, their quotation would be an act of needless indelicacy. "Beaumarchais," says M. Maurice, "defined a gentleman to be 'an animal that has debts'; and the Restoration had not degenerated from the days of Beaumarchais. In 1818, out of 151 prisoners for debt in Sainte-Pélagie, 99 were gentlemen, or so called." Amongst these are found "the names of a minister (M. de Martignac) two peers of the Restoration, three generals of division, and nearly all the sons of the illustrious men of the Empire. But what grieves me more, is to observe, over and over again, the name of a member of the Academy of Sciences, Professor in the *Collège de France*, and Examiner at the Polytechnic School."—"Napoleon paid the debts of the Abbé Sicard three several times, and Talma's oftener, but no one was found to pay those of our philosopher. While in prison, he was put on the retiring pension (*en retraite*); but his pupils showed more heart than his colleagues. Every Wednesday, three or four of them made a school-pilgrimage to the Rue de Clichy, demanding a lesson, for which they paid ten francs each; and to these Wednesdays the old man looked eagerly forward, as at once furnishing him with a little money, and affording him the opportunity of a little mathematical recreation."

One or two of the more remarkable cases which the debtors' registers present may be quoted, as illustrations of the working of the system. James Swan, an American merchant, was committed to Sainte-Pélagie on the 28th of July, 1808, for a sum of 625,640 francs (upwards of 25,000*l.*), and re-passed the gates, for the first time, on their opening to the Revolution, on the 28th of July, 1830, twenty-two years afterwards, to a day. This man, possessed of a fortune amounting to nearly four millions of francs, denied the justness of the claim beyond the sum of 6 or 7,000 francs, at the most, and determined to pass his life in prison, rather than obey a judicial sentence which he considered unjust. Having, first, caused it to be intimated to his wife and children that he would disinherit them to the last farthing of his property if they paid the debt, he furnished his prison apartment in a style of princely magnificence, and hired, in the Rue de la Célé, opposite the gates of Sainte-Pélagie, a spacious dwelling, with coach-house and stables, for his friends, cooks, &c. For the former class, he kept two carriages; and they were commissioned to appear for him, and spend his money, in the Bois-de-Boulogne, public streets and promenades, balls and theatres. "A curious original was James Swan. His strutted and attitudinized in his prison, like Chodruc-Duclos in his rags:—it was his method of flinging a defiance in the face of society. Consistent in his determination, he was preparing to return to his prison, after the events of the 'three days,' when, on the 31st of July, he was seized with apoplexy at his temporary lodging," and consigned to the closer and longer imprisonment of the grave. The motives of the well-known M. Ouvrard are less honourable, though the consequences to himself were less severe. Not disputing the debt for which he was detained, he yet refused to pay it, and determined, like Mr. Swan, to undergo his imprisonment, which, as a Frenchman, could not, in his case, exceed five years. He, too, led a life of princely expenditure in his prison; and, amongst other instances of his extravagance, it is told of him, that, for the purpose of adding a neighbouring room to his establishment, he paid the debt of the prisoner who occupied it. "One day, when M. de Villèle, the Finance Minister, was dining with him, the latter urged him to settle matters with Séguin, representing the scandal which his conduct reflected on the government, which had so long retained him as Contractor General. '*Parbleu*, Monseigneur!' replied Ouvrard; 'you speak very much at your ease. I am here for five years, for five millions of money: I gain, therefore, by my imprisonment, one million a year; and if you know of any speculation at once more lucrative and sure, I am not obstinately wedded to *this*, observe! In that case, I will pay to-morrow.'" For the sake of its honourable contrast, we may add to these the case of Dante, the Conde de Foscolo, patriarch of Jerusalem, who was incarcerated for 100,000 francs, at the suit of a curé of Paris, and liberated by an accidental omission in the deposit of the *aliment* money required by law on the part of the detaining creditor,—after an imprisonment of upwards of six years. "But the patriarch was an honest man. When he had recovered his liberty, and was under no further compulsion to do so, he paid every farthing of his original debt; and the curé eventually lost nothing but those costs which a more evangelical spirit would have prevented his incurring."

In the night of the 3rd-4th January, 1834, the debtors were removed from Sainte-Pélagie to the new prison in the Rue de Clichy,—erected by the city of Paris on the site of the Hôtel Saillard, at a cost, including the site and buildings themselves, of two millions of francs. In the strange mutations that so many an edifice has undergone in that often-revolutionized metropolis within the last fifty years, the Hôtel Saillard has had its share. The walls that now echo to the orgies of such tenants as form the population of a debtors' prison, resounded, under the Directory, with the fierce debates of the famous club of the *Clichians*, and under the Restoration to the music and measured movements of the dance led by the Duchesse de Berri. The prison adjoins the walls of the new Garden of Tivoli; and has, itself, a garden for the exercise of the prisoners, "so fine, and finely kept, that they might suppose themselves in the grounds of a chateau," and a covered promenade for bad weather, consisting of "a hall, one hundred and forty-three feet in length, and eighteen broad, adorned with eighteen columns, and pierced by four great doors and sixteen windows opening upon the garden." Each prisoner has a sleeping cell to himself, and the opportunity of beguiling his time with a variety of games, for which the garden and winter hall are especially arranged. No wonder that the prisoners who came hither from Sainte-Pélagie, with its gloomy courts and wretched accommodations, fancied themselves suddenly transported to a fairy palace; and that their creditors complained loudly that such an imprisonment resembled rather a *vie de chateau* or *partie de campagne* than a place of punishment. The answer of the authorities is a distinct admission of the charge. A debtors' prison, they say, is *not* a place of punishment, nor a debtor a malefactor, *as such*. The custody of the debtor's person is the sole object of his consignment to Clichy; and having the guardianship of men wretched enough in the misfortunes which have brought them thither, and in their separation from their families, they deem it both wisdom and humanity to provide for them as much of freedom and enjoyment as is compatible with that one object. Freedom to labour at their respective professions, as well as the means of amusement, are furnished to the prisoners; and, so long as imprisonment exists at all, as the penalty for debt, no wiser course can be adopted than that which obviates some of its worst consequences to the debtor himself, and suggests a temperate use of a very questionable weapon to the creditor, by limiting his power, when he would employ it for vindictive purposes.

At Sainte-Pélagie, as in all the other prisons of Paris, the first Revolution has left its handwriting on the walls; but not in those fearful characters which its ensanguined fingers traced on most of the others. Sainte-Pélagie had no direct communication with the revolutionary tribunal, whose place of torture was the Conciergerie. The registers of this ancient prison have, however, many a terrible record previous to those which belong to the Reign of Terror itself; and of these a single example—a copy of the sentence passed on Ravaillac—may show how such a series of documents may be an instrument for testing the civilization of the respective ages to which they severally belong. The commitment of the prisoner is dated "Saturday, 16th May, 1610;" and on the margin opposite is the sentence:—

Condemned to make the *amende honorable*, before the principal church of Paris, whither he shall be taken and conducted in a tumbrel, there, naked to his shirt, and carrying a burning torch of two pounds weight, to say and declare that miserably and traitorously he hath committed the said most wicked, most abominable, and most detestable parricide, and slain the said lord the King with two stabs of a knife in the body; whereof he repenteth and asketh pardon of God, the King, and the law. Thence conducted to the Place de Grève, and on a scaffold there erected to be torn with red-hot pincers on the breasts, arms, thighs, and calves of the legs; his right hand holding the knife with which he committed the said parricide, to be burnt and consumed with the fire of sulphur; and on the places where he shall be torn with hot pincers, to be poured molten lead, boiling oil, and burning rosin, wax, and sulphur mingled together. This done, his body to be drawn and dismembered by four horses, his limbs and body consumed by fire, reduced to ashes, and scattered to the wind. All and every his goods are declared to be acquired and confiscated to the King, by decree of the Court of Parliament, of the 27th of May, 1610. Pronounced by Maistre Daniel Voysin, and executed the same day.

The extract from the registers of the Parliament, collated by the copy printed at Paris in 1610, adds what follows, after the words *acquired and confiscated to the King*:—

Orders, that the house in which he was born shall be demolished, the proprietor being first indemnified, and that on its foundation no other building shall ever be erected; and that in a fortnight after the publication of the present decree, to sound of trump and public cry in the town of Angoulesme, *his father and his mother shall quit the kingdom, to which they are forbidden ever to return, on pain of being hanged and strangled, without other form or figure of process.* Forbids his brothers, sisters, uncles, and others henceforth to bear the said name of Ravaillac; enjoins them to change it for some other, *on the same penalties;* and orders the substitute for the *procureur-général* du Roy to cause the present decree to be published and executed, on pain of being made answerable; and before the execution of the aforesaid Ravaillac, ordered that he shall be again put to the question, for the discovery of his accomplices. Pronounced and executed the 27th of May, 1610. Signed "Voysin."

The disgust inspired by proceedings like these could be in no degree enhanced if the sentence had been pronounced by a council of savages round their watchfires. The spirit of that portion of the decree which launches penalties against the innocent relatives of the assassin,

seems directly borrowed from their barbarous justice, which, for the purpose of avenging itself on an individual, exterminates a tribe.

"The prisoner," says our author, in allusion to the primitive conditions of life, "is the vanquished of society; and a wide step has already been made towards civilization when men have attained that point at which they cease instantly to slaughter the vanquished." In the first stage, however, of the triumph which the prison and the court of justice achieve over the wild and savage law of the strongest, the result of the unrefined deliberations of the latter is generally either acquittal or death. The complicated machinery of graduated punishments belongs to a more advanced wisdom and improved civilization. The French Revolution, when all the settled arrangements of society were broken up, flung it back, for the moment, on the practices of barbarism, and the philosophic contrivances of centuries refused to work. The revolutionary tribunal, like the primitive judicial assemblies, had, accordingly, two sentences only—liberation or the guillotine. The shades and distinctions of what it held to be crime went for nothing—were never inquired into. The plea of "extenuating circumstances" was a lost influence in the judicial balance. To be accused was to be capitally doomed, unless the accusation could be disproved altogether. *Once only*, though old age and infancy and womanhood were amongst the subjects of its inquiries, do the registers of the Conciergerie exhibit the record of a less penalty than death—in favour of a youth of fourteen, condemned to the pillory and ten years' imprisonment, for an alleged share in the pretended conspiracy of the prisons. The names of Marie Antoinette and Philippe of Orléans are written on its pages, beside a host of others, more or less illustrious, more or less obscure, charged with a great variety of new and unintelligible offences—but all under the seal of one common condemnation, the grave. The horror and disgust with which these documents are perused, are now and then softened into tears, by some record of womanly love triumphing over the fear of death:—like that of the young wife who, hearing its sentence passed upon her husband, resolved to share his grave. A word was sufficient to insure her condemnation; and thus coldly, without pity for her motives, or respect for her device, or a word of despair, does this dreadful Doomsday Book keep the record of her fate:—

Sitting of the Revolutionary Tribunal, the 11th Germinal, year 2. Victoire Regnier, wife of Lavergne Champlaurier, ex-commandant of Longwy, aged 26, native of Angoulême, residing in the Rue Traversière, Faubourg Saint-Germain, in Paris—convicted of having uttered expressions tending to the Restoration of Royalty, by exclaiming this day, in one of the halls belonging to the Revolutionary Tribunal, *we want a King*; and repeating this sentence with great pertinacity—*is condemned to death.*

Amid this temporary deposition of mercy and of justice, a sort of cynicism had sprung up, and men breathed the atmosphere of the prisons, though tainted with death, without horror, and talked quaintly and jested familiarly with the phantom that stalked through their dungeons,

Scoffing his state, and grinning at his pomp.

Death (says M. Maurice) was the order of the day; the guillotine seemed the natural lot of each. They had accustomed themselves to it, and played with it, and gave it nicknames—much after the fashion in which our soldiers of Austerlitz and Marengo trifled with the cannon, which they called *Sans-gêne* and *Le Brutal*. At first they beguiled their time with music; but their instruments being all withdrawn, they were reduced to patriotic hymns, sung in chorus morning and evening,—and this they called *prayer*. They read, chatted, made love, smoked, spun verses, filled up *bouts rimés*, drank champagne, played at cards, dominoes, draughts, or—*the guillotine!* This strange game was played as follows:—They imitated the Revolutionary Tribunal, with its two sections of *Liberty* and *Equality*. Those who had already passed it with impunity, mimicked the voice and exaggerated action of Fouquier-Tinville, and of Liendon and Naudin, his worthy substitutes, or the stupid importance of Dumas, Subleyras, Deliège, and Denison. Then, there were official defenders, careful not to commit themselves. The accused, of course, was always condemned: then dressed for the gallows, and, laid upon a chair, upset on the floor. The chair was pushed in a given manner, and the culprit was to fall gracefully, on pain of going through the whole ceremony again!—Bailly returned from the Tribunal, where his hearing had been adjourned to another sitting, rubbing his hands:—"*Petit bonhomme* is alive yet," he said, to those of his companions who questioned him as to his fate. Every one knows his sublime reply to the soldier who said to him "Thou tremblest, Bailly!"—"Yes, my friend, but it's with cold!"

The constitutional bishop Lamourette, who disputed, with Anacharsis Cloots, the conscience of each victim as he returned from the tribunal condemned, went to the scaffold himself with a jest.

A crowd of people surrounded the cart which Castine was about to ascend, shouting, "To the guillotine! to the guillotine!"—"I'm going there, *canaille!*" exclaimed the old soldier; "can't you wait?"—Sometimes, in the midst of their inconceivable mirth and feverish intoxication of spirits, accused and condemned would suddenly quit the table, at which some were sitting for the last time, and crowd to the window, to catch the drunken voice of the newsman, shouting, "Here you have the list of the twenty-five [or thirty or forty] brigands who have won to-day in the lottery of the holy guillotine!"—Such being the terms in which he announced the list of the condemned or executed.

When such were the coolness and indifference within the walls of the prisons, we need not wonder that a speculator was found out of doors cynical enough to project and publish a journal devoted merely to a list of the executed. Of this journal, ten duodecimo numbers, of thirty-two leaves each, were published; and the work is known to modern collectors as the *Journal des Guillotines!*

That they who lived amid events like these should have lost, for the time, all sense of discrimination, and bequeathed to the generation that immediately succeeded them some portion of their own unreasoning horror, was nothing more than natural: but it is time, nevertheless, that this Revolution should be redeemed from some of the exaggerations and relieved from some of the hard names under which it has so long suffered. The passions are more eloquent witnesses than figures, and more readily listened to for a time, but, amid their other rhetorical gifts, the former have a trick of amplification, which requires the correction of the latter. It was, of course, impossible that the waves of that moral ocean which had been so long ice-locked should roll themselves into freedom without causing many a wreck; and they who point to the comparatively bloodless drama of the second revolution must not forget that this magnificent event was the direct heir of the first. The concentrated energy and sublime movement of this great epic, with its perfect unities of action, time, and place, are amongst the inestimable gifts which the terrible convulsion of 1789 purchased with its crimes, and bequeathed with its virtues. The blood shed at the first period should be divided betwixt the two—for it paid for both triumphs. What was wasted in the one was, doubtless, saved to the other. Of that terrible slaughter no man will now or hereafter come forward as the apologist; but our author proves that, seen through the medium of the natural horror which it inspired, it has been strangely distorted and magnified. Unhappily, in this world of mixed motives and events, good is nearly always reached through much of evil; but, notwithstanding all the fiery passions which were unchained to the work of destruction—and the entire subversion of every moral and legal restraint—the entire number of victims of the Revolution in Paris amounted only to 2,742! A fearful sum of crime and misery, no doubt, does that total express, but not one by any means justifying the infamous pre-eminence which has been assigned to that Revolution over all other social and moral convulsions. Few who have trembled over the narratives of the time are probably prepared for a resulting number like this:—"There is no contagious malady," says our author, "which does not cost the capital a heavier loss every ten years,—no great battle in which a larger amount of lives are not flung away."—"And what battle," he adds, "had ever for its motive longer or heavier grievances? When was ever war more just or more sacred than this of the new order of things against the old? And when did the blood shed on the battle-field ever yield a grander result of liberty, equality, and law than the blood poured out on the scaffold in the old Revolution?" Why is this episode to stand so prominently out from a canvas which represents also the Massacre of St. Bartholomew, the Revolution of the edict of Nantes, and the Dragonnades—even if any of these latter horrors had been justified by their motive or redeemed by their event?

For the purpose of proving his position, the author analyzes and collates the registers of the prisons and the records of the Revolutionary tribunals:—and, as an example of his manner, and as one of the most important parts of the inquiry, we may refer to his sifting of the evidence in the case of the Massacres of the Prisons—one of the most dreadful scenes in all that dreadful drama. It is fearful indeed to follow him through this portion of the prison registers, with their dark hints and laconic records; but one pleasant result of that inquiry, as we have said, is the proof that the number of victims has been immensely over-estimated. At the Conciergerie, MM. Berville and Barrière, followed by nearly all the historians of those events, give a contingent of 2,214 persons slaughtered,—which our author reduces, by arguments founded on the exhibition of figures, to below 80; their cipher of 2,193, at the Salpétrière he changes to 45; and of 6,000 victims at Bicêtre, according to Peltier, and 1,760 according to Barrière and Berville, he certifies to no more than 163:—"What must ancient history be," he exclaims, "if modern history be written thus!" M. Maurice pursues his inquiry through the various prisons of the metropolis;—throwing shrewd doubts, as he passes, on certain other tales of horror—such as the often-repeated one of the glass of blood presented to Mademoiselle de Sombreuil. These researches form the only valuable contribution of his volume to history; and have occupied too much of our space to leave us room to follow him through his anecdotical account of the remaining prisons.

Odontography, &c., a Treatise on the Comparative Anatomy of the Teeth, their Physiological Relations, Mode of Developement and Microscopic Structure in the Vertebrate Animals, illustrated by upwards of 150 Plates, by Richard Owen, Esq. F.R.S., &c., 8vo. & 4to. Part I.—The important functions performed by the teeth, and the diversity in their structure, have rendered the characters to be derived therefrom of a primary importance to the systematic naturalist, whilst the physiologist traces, in their microscopical structure, some of the most beautiful of the animal organisms. A work, therefore, on this subject, from the Hunterian Professor of the Royal College of Surgeons,

illustrated in so profuse and elaborate a manner as the present is intended to be, cannot fail to be acceptable. The present Part is, however, exclusively confined to the dental system of fishes, which is not yet completed. Notwithstanding the great variety of form and structure which occurs in the teeth of fishes, comparatively little attention has been paid to them, owing to the circumstance that here, from their variation, not only in the species of a genus, but in the individuals of a species, they do not possess such claims for the examination of the systematic writer as in the mammalia; but this very circumstance renders this work more valuable to the comparative physiologist. After a few general observations on the number, form, substance, structure, situation, and mode of attachment of the teeth of fishes in general, each of the orders, families, and chief genera of fishes is reviewed in respect to its dental system. The great body of the work is therefore purely descriptive, and affords but little material for popular extract. A singular modification, not only in the structure but in the functions of the teeth, is found in the family of the climbing perches:—"There is a small family of fishes, in which the pharyngeal bones are so modified as to be subservient to the respiratory as well as the digestive functions; the surface of these bones is increased by being produced into laminæ variously convoluted, and intercepting labyrinthiform spaces, in which a certain quantity of water can be kept in store. Thus provided, many of these fishes voluntarily quit their proper element, and all of them can maintain life for a considerable time out of water." The work is to consist of three Parts, and will, when completed by similar details of the teeth of the mammalia and reptilia, constitute one of the most valuable additions which have long been made to our works on comparative anatomy.

List of New Books.—Edinburgh Cabinet Library, Vol. XXVIII. "Iceland, Greenland, and the Faroe Islands, with maps and engravings," fc. 8vo. 5*s.* cl.—History of the Jews from the taking of Jerusalem by Titus to the Present Time, 12mo. 4*s.* cl.—Royle on the Productive Resources of India, 8vo. 14*s.* cl.—The Pictorial Edition of Shakspere, "Histories, Vol. II." royal 8vo. 17*s.* 6*d.* cl.—The Prophetic Almanack and Messenger for 1841, 12mo. 2*s.* 6*d.* swd.—A Birthday Present, fc. 8vo. 2*s.* 6*d.* cl., 4*s.* silk.—Railway Time and Fare Table, 18mo. 2*s.* cl.—The Recreation, for 1841, with 6 engravings. 12mo. 5*s.* cl.—Geary's Designs for Tombs and Cenotaphs, 8vo. 10*s.* 6*d.* cl.—The Old Oak Chest, by the Author of 'Charlie's Discoveries,' square 16mo. 3*s.* 6*d.* cl.—The New Excitement for 1841, 18mo. 3*s.* 6*d.* cl.—Dictionary of Greek and Roman Antiquities, Section I. 8vo. 10*s.* 6*d.* swd.—Fisher's Drawing-Room Scrap-Book for 1841, 4to. 21*s.* bd.—Fisher's Juvenile Scrap-Book, 1841, 8vo. 8*s.* cl.—Cowper's Poems, 2 vols. 32mo. illuminated title, 5*s.* cl.—Thomson's Seasons, with illuminated title, 32mo. 2*s.* 6*d.* cl.—Thomas Moore's Poetical Works, Vol. I. fc. 8vo. 5*s.* cl.—Leighton's Flora of Shropshire, 8vo. 24*s.* cl.—Johnson's Every Lady her Own Gardener, 3rd edit. 18mo. 2*s.* cl.—Tyas's Legal Hand-Book, "Commercial Law," 18mo. 2*s.* cl.—Christian Literature, "Evidences," royal 8vo. 14*s.* cl.—Sermons, by the Rev. R. P. Beachcroft, 1 vol. 8vo. 9*s.* cl.—Confidence in God, &c. fc. 8vo. 5*s.* bds.—Moore's Christian System Vindicated, fc. 8vo. 8*s.* cl.—Paley's Natural Theology, 18mo. 2*s.* 6*d.* cl.—Marshall on Sanctification, new edit. 18mo. 2*s.* cl.—Cennick's Thirty-nine Village Discourses, royal 18mo. 3*s.* 6*d.* cl.—The Church of God, a Book for the Age, by the Rev. J. D. Hull, 12mo. 4*s.* cl.—Le Nouveau Trésor, by M. E. S., 7th edit. 12mo. 3*s.* 6*d.* bd.

[Advertisement.]—*The Sporting Oracle and Almanac of Rural Life.*—To the Editor of the *Athenæum*.—Mr. Hood having attempted to establish a charge against me, through the medium of your advertising columns, you will, no doubt, afford me the same channel for conveying to the public that answer which Mr. Hood has been more than commonly unwise to provoke. Mr. Hood quite correctly gives your readers to understand that all dealings between himself and me have ceased, excepting such as are left to the decision of courts of law. The terms of his announcement, however, would scarcely lead them to conjecture that what he terms *his renunciation* consisted in a written notice distinctly conveyed by *me* to *him*, at the period of which he speaks, that then, or at no other time, would I again have anything whatever to do with him, in any matter or on any terms. My positive refusal to continue a connection with Mr. Hood arose from his declining popularity as an author, and the consequently diminished sale of his works not realizing the money I have been in the habit of advancing to him, prior to their publication; and to the fact of a heavy stock of his last works, which remained on hand, having been lately seized by his creditors, I am to attribute an animosity, the exhibition of which has, however, recoiled upon himself. With respect to the article in question, which has occasioned Mr. Hood to make this unhappy exhibition,—though he is careful not to say as much in terms,—yet, by that species of dishonesty which consists in the *suppressio veri*, he leaves it to be inferred that it had formerly appeared in some work with which *I* had no connection,—and that the copyright, in fact, was not mine. The truth is, that, for this paper and another, which appeared in a work called "'Sporting,' by Nimrod," I some time ago gave Mr. Hood much too large a sum. Their reproduction in the 'Sporting Oracle and Almanac of Rural Life,' is an affair of my own, on which Mr. Hood, who has eaten *his* cake,—and a corner of mine, too,—has not even the right of remark; and his interference between the public and me would be a gross indecency, if it were not such a conspicuous folly. It seems scarcely worth while to discuss the question of character,—Mr. Hood's may be left to the appreciation of all or any of the respectable publishers who have had literary transactions with him, before I had, and got rid of him one after the other;—*mine* may be referred to the testimony of any *other* author who has chosen me as his channel of communication with the public,—many of whom I have the honour and pleasure to reckon as my friends.

83, Cornhill, I am yours, &c.,
Oct. 9, 1840. A. H. Baily.

Meteorological Observations made at the Apartments of the Royal Society, Somerset House, for 25 successive hours, commencing 6 A.M. of the 21st of September, 1840, and ending 6 A.M. of the following day.
(Greenwich mean time.)

By Mr. J. D. Roberton, Assistant Secretary, Royal Society.

Hours of Observation.	Barom. corrected. Flint Glass.	Barom. corrected. Crown Glass.	Attach. Ther.	Extern. Ther.	Old Standard Barom.	Attach. Ther.	Difference of Wet & Dry Bulb Ther.	Dew Point.	Rain in Inches.	Wind.	REMARKS.
6, A.M.	29.964	29.954	52.6	44.2	30.031	52.9	02.7	45		SSW	Fine—light clouds and wind.
7, ..	29.966	29.956	52.8	45.9	30.033	52.9	01.7	43		S	Do. ditto.
8, ..	29.964	29.954	54.8	49.7	30.035	53.7	03.5	45		S	Do. ditto.
9, ..	29.960	29.950	55.0	54.5	30.035	54.5	05.3	45		SW	Do. ditto.
10, ..	29.949	29.939	55.3	57.0	30.023	55.4	06.2	47		S	Do. ditto.
11, ..	29.934	29.926	55.6	58.0	30.010	56.3	07.5	46		SW var.	Do. ditto.
12, ..	29.918	29.908	55.7	59.9	29.994	57.3	08.9	46		W var.	Do. ditto.
1, P.M.	29.894	29.884	55.9	61.3	29.974	57.7	09.1	46		S	Do. ditto.
2, ..	29.890	29.880	55.9	59.3	29.968	57.8	07.7	47		S	Cloudy—light wind.
3, ..	29.877	29.867	56.0	58.8	29.958	58.0	07.1	46		S var.	Do. ditto.
4, ..	29.861	29.853	56.0	57.5	29.944	58.0	06.9	47		S	Cloudy—brisk wind.
5, ..	29.850	29.840	55.8	56.3	29.932	57.6	05.2	48		S	Ditto ditto.
6, ..	29.833	29.825	55.4	55.3	29.915	57.0	05.3	48		S	Ditto ditto.
7, ..	29.814	29.804	55.0	54.7	29.885	56.4	05.6	49		S	Ditto ditto.
8, ..	29.800	29.790	55.2	54.7	29.865	56.3	03.6	48			Overcast—brisk wind.
9, ..	29.780	29.770	55.2	54.4	29.845	56.3	02.5	48			Ditto—light rain and wind.
10, ..	29.742	29.732	55.3	54.0	29.804	56.3	01.8	49			Ditto—continued rain and wind.
11, ..	29.702	29.696	55.3	54.5	29.766	56.2	02.0	51	.050		Ditto—brisk wind.
12, ..	29.690	29.682	55.3	53.5	29.760	56.2	01.9	51			Cloudy—stars visible N.E.
1, A.M.	29.672	29.662	55.4	52.6	29.734	56.3	01.7	48			Do. ditto.
2, ..	29.632	29.626	55.3	52.5	29.695	56.0	02.2	48	.011		Overcast—light rain and wind.
3, ..	29.614	29.606	55.3	52.7	29.673	56.0	03.0	48			Ditto—moon & stars slightly visible.
4, ..	29.576	29.566	55.3	51.8	29.639	56.0	02.4	49			Cloudy—light wind.
5, ..	29.556	29.546	55.3	52.3	29.614	56.0	02.8	48		S	Do. ditto.
6, ..	29.524	29.516	55.5	52.4	29.590	56.0	03.6	47		S	Fine—lt. broken clouds—light wind.
	29.798	29.789	55.2	54.3	29.949	56.1	04.4	47	.061		

The observations of the Barometer (Flint and Crown Glass) are severally corrected for temperature, as also for Capillarity.

TENTH MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

[*From our own Correspondents.*]

SATURDAY, SEPTEMBER 19.

Section A.—MATHEMATICAL AND PHYSICAL SCIENCE.

Prof. Forbes in the chair.

'On the Decomposition of Glass,' by Sir David Brewster.

There is no subject more curious or more instructive than the disintegration of crystallized and uncrystallized bodies, either by the direct influence of chemical agents, or the slow process of natural decomposition. At the Edinburgh Meeting of the Association, I submitted (said Sir David) to this Section a brief account (which has been since published in an enlarged form in the Edinburgh Transactions) of remarkable optical phenomena produced by the instantaneous action of water and other fluids on crystals, and on their subsequent decomposition when placed in their saturated solutions. Since that time I have had occasion to examine the phenomena of decomposed glass, both of that which is found in Italy, of which I have received the finest specimens from Mrs. Buckland and the Marquis of Northampton, and of other specimens recently found in making excavations among the ruins of the Chapter-house of the Cathedral of St. Andrews. In decomposed glass, the decomposition commences in points, and extends itself either in planes so as to form thin films, or in concentric coats so as to form concentric films. When the centres of decomposition are near each other, the concentric films or strata which they form interfere with each other, or rather unite, and the effect of this is, that the glass is decomposed in films of considerable irregularity, their surfaces having a finely mammillated appearance, convex on one side and concave on the other. The films thus formed are of extreme beauty, and afford, by transmitted light, colours of infinite beauty and variety, surpassing anything produced in works of art. They have the effect of dissecting, as it were, the compound surface of the solar spectrum, or of sifting and separating the superimposed colours, in a manner analogous to what is produced by coloured and absorbing media. I have succeeded, indeed, in producing one or more bands of white light incapable of decomposition by the prism; and there can be no doubt that they will be found to exercise a similar or an analogous action on the leading rays of the thermometric spectrum. In the decomposed glass from St. Andrews, a change of a very different kind is effected. In some cases the siliceous and the metallic elements of the glass are separated in a very singular manner, the particles of silex having released themselves from the state of constraint produced by fusion and subsequent cooling, and arranged themselves circularly round the centre of decomposition; while the metallic particles, which are opaque, have done the same thing in circles alternating with the circles of the siliceous particles. This restoration of the silex to its crystalline state, is proved by its giving the colours of polarized light, and possessing an axis of double refraction.—The notice was illustrated by diagrams and specimens of the different kinds of glass referred to.

Prof. Forbes observed that few persons can form any correct conception of the total amount of the value of glass used in the various optical instruments, on the correct action of which so much depended. Whether the decomposition which Sir David Brewster had now brought under notice, arose from the action of the atmosphere, or from intermolecular action, as Sir David Brewster seemed to think, or from some original defect in making or annealing the glass, it was of the utmost consequence. Dr. Traill had given him a specimen of a piece of plate glass manufactured near Liverpool, which, when polished, proved to be filled with fissures and flaws in the interior; and he informed him that the manufacturers had no means of ascertaining the defect, which frequently occurred, until they had gone to the expense of polishing the plates.—Sir David Brewster said, that the value of the glass employed in philosophical instruments was indeed incalculable, and that the most valuable glass articles manufactured by Frauenhofer,* of Munich,

* M. Lamont, the Professor of Astronomy at Munich, who is in the constant habit of using Frauenhofer's glasses, was not present at this conversation; but he afterwards informed Sir David Brewster that there was an easy and effec-

seemed to be peculiarly liable to some superficial decomposition of this kind. A prism of this glass in the Observatory of Paris had become absolutely black. A prism belonging to himself had become quite blue on the surface, although as yet its action on light was not affected. The large object glass of the principal telescope in the Observatory of Edinburgh had begun to show decided symptoms of superficial decomposition; and many other instances also could be mentioned. He considered it of the utmost importance that a remedy should be discovered and applied.—Prof. Forbes mentioned some instances of this kind of decomposition taking place in telescopes on the continent, which showed that it was nothing peculiar to our climate.—Sir David Brewster did not think it arose from atmospheric action at all, but from some mutual action of the particles of glass themselves.—Prof. Forbes, Then why is it confined to the surface? why does it not pervade the mass of the glass?—Sir D. Brewster, Because at the surface the particles have more freedom than within; and if the new compounds are larger than the glass itself, then they have power to expand.

'On the Rings of Polarized Light produced in specimens of Decomposed Glass,' by Sir David Brewster.

In the course of a series of experiments 'On the Connexion between the Absorption of Light and the Colours' of thin plates, published in the Phil. Trans. 1837, I accidentally observed under the polarizing microscope certain phenomena of polarized tints of great beauty and singularity. These tints were sometimes linear and sometimes circular, and in some specimens they formed beautiful circular rings traversed by a black cross, resembling the phenomena of mineral crystals, or those produced by rapidly cooled circular plates or cylinders of glass. Having found in the decomposed glass from St. Andrews that the siliceous particles had resumed their position as regular crystals, and arranged themselves circularly round the centre of decomposition, I was led to suppose that this was the cause of the phenomenon, and that the rings were the effect of the double refraction of the minute crystals. A few experiments, however, overturned this hypothesis, and I was soon satisfied, by a little further investigation, that the phenomena arose wholly from the polarization of the transmitted light by *refraction*, the splendid colours being entirely those of thin plates, which were sometimes arranged so as to have the appearance of concentric rings. The structure by which these effects were produced, was compared by the author to a heap of very deep watch-glasses laid one above another. When the thin films were arranged longitudinally, and were inclined to the general surface of the plate, so as to transmit the rays obliquely, the light was still polarized, but only in one plane—namely, a plane perpendicular to the plane of incidence. When a drop of *water* or *oil* was introduced between the films, the phenomena of *polarization* as well as of colour instantly disappeared. (This paper was illustrated by coloured drawings.)

'New Experimental Researches on Rain,' by Prof. Phillips.

The author proposed, by a new train of researches on the quantities of rain received on horizontal surfaces at *different heights* above the ground, and by a contemporaneous series of experiments on the *direction* and angle of *inclination* of the descending lines of rain drops, and by contemporaneous registration of wind, temperature, and moisture, to furnish additional data of importance in the theory of rain. Referring to the results obtained in his former discussion of three years' observations on the quantities of rain on York Minster (212 feet above the ground), the Yorkshire Museum (42 feet), and on the ground, made by Prof. Phillips and Mr. Wm. Gray, the author notices the statements of Prof. Bache, Dr. Daubeny, and others, on the inequality of the receipt of rain about the angles of a building and at small heights above it, in consequence of local aerial deflexions; and though in these respects the experimental results obtained in the three years' York series were liable to small objection, many reasons of importance decided that in this new course of experiments, destined to last many years, and to include a variety of contemporaneous records, the rain-gauges should be placed in an open ground. It was further determined to place them at heights above the ground corresponding with the depths below the surface to which the thermometers of Arago, Quetelet, and Forbes, are sunk—i. e., to 0, 3, 6, 12, and 24 French feet. At present, there are placed in the author's garden-ground four gauges at heights of 0, 3, 6, 12 French feet. The method of observation is of a peculiarly easy description, so that in the midst of rain the momentary rapidity of the fall of rain can be perfectly ascertained in all the gauges. For example, in a *very heavy* shower, the *maximum rapidity* of rain accumulation was 0.010 inch in 2 minutes of time, =0.300 inch in an hour. The gauges are, in common language, *of the same size*, but the author, not trusting to this supposed equality, makes the four gauges pass through a circle of positions, so that at the end of a year about twelve changes of position will have occurred, and the error of size in any one or all the gauges be equally distributed over the various positions, and the registration be finally correct, without any applied calculation. The results from June 1 to September 3, inclusive, in which period the changes of the gauges have not been sufficient to equalize their errors, are—

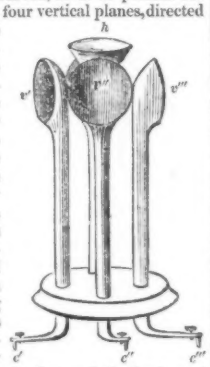
12 feet above ground	8206
6 "	8249
3 "	8314
0 "	8408

During this period it has sometimes happened that more rain fell in the upper gauges, a circumstance apparently dependent on the dryness of the air, which has been very remarkable in the early part of the period in question.

1840.	1.	2.	3.	4.
June 30	1575	1547	1509	1508
July 12	2018	2030	2046	2022
Aug. 14	2347	2315	2300	2260
Sept. 3.....	2468	2422	2394	2416
	8408	8314	8249	8206

Maximum rate .0100 in 2′ = .300 in one hour.

In the second part of his communication, the author described a new construction of rain-gauge, for the purpose of determining the direction in which rain comes, and the angle of inclination at which it descends. For this purpose a compound gauge is constructed, having five equal receiving funnels and tubes; one with a vertical tube and horizontal aperture, the other four with tubes recurved, so as to present the openings of the funnels in four vertical planes, directed to four quarters of the horizon—*h* is the horizontal funnel, *v′ v″ v‴* three of the four vertical openings, and *c′ c″ c‴* three corresponding cocks for letting off the water into a graduated tube. The rain which falls in the funnels being carefully measured *after each shower*, the observer is able immediately to determine the direction and inclination of the rain in each of the following cases. 1. If the rain has fallen in a direction exactly coinciding with any one of the vertical funnels, that and the horizontal funnel alone receive any rain. The direction thus known by observation, the angle of inclination of the descending rain from the vertical is easily calculated. 2. If the rain has fallen (in quantities *q* and *q′*) in two of the vertical gauges as well as in *h* (in quantity H), then the direction of the rain, intermediate to the positions of the two receiving vertical gauges, may be easily calculated by considering *q* and *q′* as sine and cosine; and the ratio between them being = cotangent of the angle by which the rain direction deviates from that of the gauge which received most rain. This known, the quantity (Q) which *would have been received*, in a vertical funnel directly opposed to the rain, is also calculable, being $=\sqrt{q^2+q'^2}$; and finally, the angle of inclination from the vertical at which the rain descends is calculable, its cotangent being $=\frac{H}{Q}$. Observations with this instrument have been made satisfactorily for some months, and the author has found the angle of inclination of descending rain vary from 0 to 6°, 13°, 17°, and in one case to 35°, without perceiving that these very unequal inclinations had any sensible effect on the relation of the quantities of rain received in the gauges which are placed at different elevations.



Prof. Forbes said, that, at previous meetings of the Association, doubts had been thrown upon the cause assigned by Prof. Phillips for the increased quantity of rain received in gauges placed near the ground, and the difference had been assigned to eddy winds: in particular, Mr. President Bache had shown, by convincing experiments, the great influence of these eddies, (*Athen.* No. 566.) Mr. Phillips had, therefore, taken every precaution to put this opinion to the test; and the difference in the quantity of rain received was so obvious, as to leave no doubt but that the drops were augmented by the deposition of vapour on their surface during their passage through the lower and more hygrometrically moist air.—Prof. Stevelly did not think that Prof. Phillips was decided in adopting this theory, and believed he merely stated facts which he had now placed beyond doubt, but left the explanation to be made out hereafter.—Prof. Phillips dissented, and said that he adhered to his original explanation.—Prof. Stevelly did not think that explanation would agree with the phenomena: upon looking at the numbers representing the quantities received in the gauges, as given by Prof. Phillips, not only was the quantity greater, but the difference was also increased as you came nearer to the earth. Now if vapour were depositing on them, the drops would be constantly rising in temperature, and, therefore, the quantities deposited would be diminishing, and not increasing. He had, at the meeting at Newcastle, stated his conviction that the effect, in part at least, arose from the varying inclination to the horizon of the lines in which the descending drop moved; and Dr. Robinson proposed a spherical ball to be used as a gauge, the water to be conducted by capillary attraction along a stem on which the ball was to rest. Dr. Robinson had since erected such a ball gauge close to his rain gauge, and found that it received a quantity of rain, which varied from equality to three times as much.—Mr. Espy observed, that if vapour were deposited on the rain drops, a quantity sufficient to increase the size of the drop very inconsiderably would raise its temperature to 100°.—Mr. Thom, of Rothesay, mentioned that he had kept a registry of rain for upwards of twenty-five years, and had tried the experiments mentioned by Prof. Phillips, having elevated his gauges from one to seventy feet above the ground. He had, of course, met with many very curious results. On the whole, he was convinced that the chief thing to be determined was, the quantity of rain actually received by the ground; and he was certain there were no means of ascertaining this, but by gauges whose mouths were laid exactly even with the ground, as an elevation of a few inches was sufficient to vary the result.

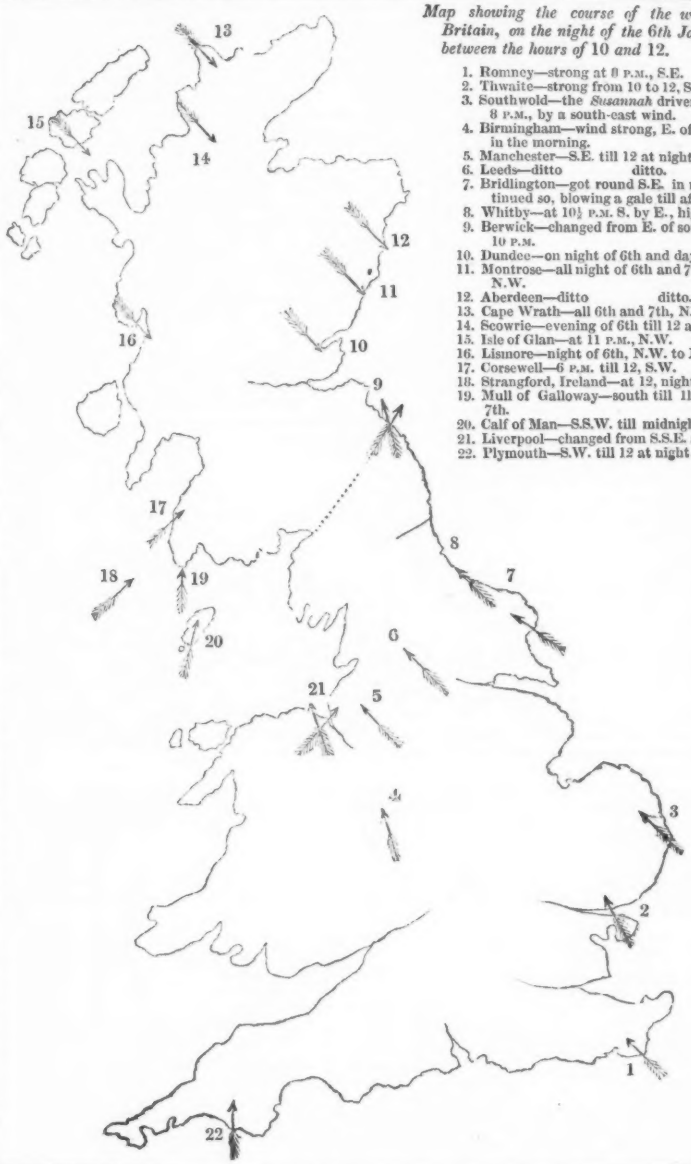
Prof. Forbes 'On Excessive Falls of Rain.'—Prof. Forbes said, It appears, from the report of the Birmingham meeting of the British Association, as given in the *Athenæum* (No. 618), that doubt has been thrown on the statement of the remarkable fall of rain cited in my former report. I was not present at either of the discussions alluded to; I therefore take this opportunity of stating the authority upon which these very surprising falls of rain were admitted into my report,—authority so ample, that, as a historian of science, I could not have omitted them, improbable as they do most certainly appear. The fall of thirty inches of rain within twenty-four hours, took place at Genoa [not Geneva, as printed in the report] on the 25th of October, 1822. An assertion to this effect having appeared in a Genoese newspaper, the editors of the *Bibliothèque Universelle* wrote immediately to make the necessary inquiries as to an observation so unprecedented. The reply which they obtained from M. Pagano, "observateur exact," is given at length in their journal (Vol. xxii., partie *Physique*, p. 67), and is not, I think, the less satisfactory, because this result was obtained by the most inartificial of rain-gauges. "Deux seaux de bois presque cylindriques, dont l'un de vingt-quatre et l'autre de vingt-six pouces de hauteur, qui m'avoient servi pour quelques expériences sur la vendange, étoient restés vides dans mon jardin. La pluie de

tual remedy for this tendency of Frauenhofer's glass to deteriorate on the surface, which was, to rub it frequently with the finer parts of whiting, prepared by elaborating a mass of whiting in water, the fine powder to be dried and used on old soft linen.

Vendredi 25 Octobre n'avoient pas encore cessé de tomber que déjà ils en étoient remplis." He then proceeds to state on what grounds he infers that four inches more of rain fell after the larger vessel had been filled, making a total of thirty inches French (thirty-two English); and adds a statement of several facts, to show that the effects of the deluge in the neighbourhood bore a proportion to the magnitude of the cause. M. Arago, quoting the result, adds:—"Ce résultat inouï inspira des doutes à tous les météorologistes: on soupçonnait une erreur d'impression; mais M. Pagano, observateur exact, a écrit aux rédacteurs de la *Bibliothèque Universelle* une lettre qui *met le fait hors de toute contestation*." (Ann. de Chim. et de Phys. xxvii. 407.) Fortunately, however, this *local deluge* (for it appears, by the letter of M. Pagano, to have extended but a very short distance,) is nearly rivalled by a similar *fact* recorded in the south of France by an experienced observer, who seems to have been in the practice of measuring the fall of rain for twenty-three years at least, M. Tardy de la Brossy, of Joyeuse, Dep. de l'Ardèche. M. Arago, who records the observation, and gives it the weight of his authority, does so in these words:—"Le 9 Octobre 1827, dans l'intervalle de vingt-deux heures, il est tombé, dans la même ville de Joyeuse 29 pouces 3 lignes d'eau (vingt-neuf pouces trois lignes): J'écris le résultat en toutes lettres, afin qu'on ne croie pas à une faute d'impression." (Ann. de Chim. et de Phys. xxxvi. 414.) When I add, that these two results, surprising, and perhaps unexampled as they are in the history of science, have, on account of the testimony by which they are established, been received not only in France and Switzerland, but in Germany and England, I conceive that they are undoubtedly entitled to stand part of the history of meteorology. I proceed to add a notice of a few other remarkable falls of rain, though there is nothing on record comparable to the two preceding ones. Flaugergues, the eminent meteorologist of Viviers, obtained, on the 6th of September, 1801, 13 inches 2.3 lines (14½ English inches) of rain in eighteen hours. On the 20th of May, 1827, there fell, at Geneva, 6 inches of rain in *three hours*. At Perth, on the 3rd of August, 1829, there fell 4-5ths of an inch in half an hour. On the 22nd of November, 1826, I observed at Naples a fall of 9-10ths of an inch of rain and hail in thirty-seven minutes. Were the equatorial records of the fall of rain as minute in respect of distribution as of total amount, we should doubtless have records of enormous falls within twenty-four hours; none so recorded, that I am aware of, approaches the results at Genoa and Joyeuse. From the total quantities measured, it is evident that the result for particular days must be enormous. Don Antonio Lago observed at San Luis, Maranham (2½° S. latitude), a fall of 23 feet 4 inches 9.7 lines in a year. Roussin states (his account is confirmed) that at Cayenne (5° N. lat.) in February 1820 there fell, in ten hours, 1.25 inches of rain; and between the 1st and 24th of February, *twelve* feet 7 inches. From observations in the Ghauts, it appears that, in the eastern hemisphere, in lat. 18° N., 302.21 inches of rain have been measured; a quantity exceeding that stated on the authority of Roussin, and which was once considered almost incredible; and of this quantity (25.2 English feet), nearly 10 feet fell in the month of July alone.

Prof. Stevelly acknowledged that he was one of those who had expressed doubts of the accuracy of the statement; in fact, he had supposed it to have arisen from an error in writing down the result; and he was not sorry that he had been instrumental in causing Prof. Forbes to come forward with so triumphant a confirmation of the original statement, and such a mass of new and confirmatory evidence. It certainly had seemed impossible to him, that, in one day, as much rain should have fallen in one spot as fell in England in a year.—Prof. Phillips said this was not quite correct, as at Keswick more than 70 inches fell in a year, and at Ullswater more than 60.—Mr. Thom observed, that 70 inches of rain in a year had fallen at Rothesay.—Mr. Espy mentioned, that, in a late number of *Silliman's Journal*, would be found some accounts of surprising falls of rain, nearly as remarkable as those brought under notice by Prof. Forbes.

Mr. Espy's paper 'On Storms,' which excited much attention, was appointed for half-past twelve o'clock, and that hour having now arrived, the President called on Mr. Espy, who commenced by stating that he had found by examining simultaneous observations in the middle of storms, and all round their borders, that the wind blows inward on all sides of a storm towards its central parts; towards a point if the storm is round, and towards a line, if the storm is oblong, extending through its longest diameter. Mr. Espy stated that he had been able to investigate within the last five years seventeen storms, without discovering one exception to the general rule. He could now only give a specimen of the manner in which he had proceeded. He presented the accompanying map of Great Britain, on which are drawn arrows representing the course of the wind on the night of the 6th of January, 1839.



Map showing the course of the wind in Great Britain, on the night of the 6th January 1839, *between the hours of* 10 *and* 12.

1. Romney—strong at 8 P.M., S.E.
2. Thwaite—strong from 10 to 12, S.S.E.
3. Southwold—the *Susannah* driven on shore at 8 P.M., by a south-east wind.
4. Birmingham—wind strong, E. of south, till one in the morning.
5. Manchester—S.E. till 12 at night.
6. Leeds—ditto ditto.
7. Bridlington—got round S.E. in night, and continued so, blowing a gale till after midnight.
8. Whitby—at 10½ P.M. S. by E., high wind.
9. Berwick—changed from E. of south to S.W., at 10 P.M.
10. Dundee—on night of 6th and day of 7th, N.W.
11. Montrose—all night of 6th and 7th a hurricane, N.W.
12. Aberdeen—ditto ditto.
13. Cape Wrath—all 6th and 7th, N.W.
14. Scowrie—evening of 6th till 12 at night, N.W.
15. Isle of Glan—at 11 P.M., N.W.
16. Lismore—night of 6th, N.W. to N.
17. Corsewell—6 P.M. till 12, S.W.
18. Strangford, Ireland—at 12, night of 6th, S.W.
19. Mull of Galloway—south till 1h. 30m. A.M., of 7th.
20. Calf of Man—S.S.W. till midnight.
21. Liverpool—changed from S.S.E. after 10.
22. Plymouth—S.W. till 12 at night of 6th.

From this, and from documents which Mr. Espy proceeded to read, it appeared that during those hours the wind was blowing a violent gale on the north-western part of the island from the north-west, on the south-western parts from the south-west, and on the south-eastern parts a strong gale from the south-east and south-south-east; and that in the middle parts of the island it changed from south-easterly to south-westerly about those same hours—the change taking place about two hours sooner on the west side of the island than on the east side in the central parts, but much sooner in the northern parts than in the southern. The barometer also fell sooner in the northern and western parts than in the southern and eastern. From these two circumstances he thinks it highly probable that this storm moved not exactly towards the east, but a little south of east, and if so, it would be similar to some storms which he had examined in the United States. He mentioned one in particular, which occurred on the 26th of January, 1839, whose north-north-east and south-south-west diameter reached at least 700 miles, while its diameter from west-north-west to east-south-east was probably not more than 300. The south border of this storm certainly travelled towards the south of east, and Mr. Espy found that in this storm, as in many others, the barometer fell sooner to the north and west than to the south and east. A much greater difference however depended on the longitude than on the latitude of places. The

barometer was at its minimum at Cape Wrath, in the north-west corner of Scotland, two hours and a half sooner than at the Calf of Man, five hours sooner than at Edinburgh, and thirteen hours and a half sooner than at Thwaite, in Suffolk. Mr. Espy then stated that he had examined the data furnished by Col. Reid, of several hurricanes in the West Indies, and found conclusive evidence that the wind blew inwards to a central space in all these storms. Diagrams of two were exhibited:—one on the 3rd of October, 1780, in which Savannah-la-Mar was destroyed. In that storm, at its very height, the wind at Savannah-la-Mar, on the south side of the island of Jamaica, was south,—and nearly opposite to that point, on the north side of the island, the wind was north-east, or nearly in an opposite direction, for two hours at the time of the greatest violence of the storm at both places. The other storm was on the 18th of August, 1837, off Charleston, south-east. On that day, the ship *Duke of Manchester* had the centre of the storm pass over her, and, on the same day, the *West Indian* and the *Rawlins*, which were on the south-west of the *Duke of Manchester*, had the wind all day from 2 A.M. south-west, and at the same time the *Cicero* and the *Yoloſ*, on the north-east of the *Duke of Manchester*, had the wind north-east and east-north-east. The *Yoloſ* all day, till 8 P.M. Mr. Espy then stated that he had visited the tracks of eighteen tornadoes, and examined several of them with great care, and found that all the phenomena told one tale—the inward motion of the air to the centre of the inverted cone of cloud as it passed along the surface of the earth. From all these facts he demonstrated that there is an inward motion of the air towards the centre of storms from all sides; and that this is the inference which ought to be drawn from the well-known fact, that the barometer stands lower in the midst of a storm than it does all round its borders. The difficulty is, to account for the continued depression of the barometer, notwithstanding the great rush of air at the surface of the earth towards the place where the barometer stands lowest. So great did this difficulty appear to Sir J. Herschel that he stated to the British Association at Newcastle, that it appeared to him fatal to Mr. Espy's theory. It appeared to Sir John that the only way to account for the fall of the barometer was a centrifugal force in the air, arising from the whirlwind character of storms. Mr. Espy thought it probable that the following statements had never met the eye of Sir John, or he would at least have hesitated before he gave it as his opinion, that the air could not blow in towards a common centre without causing the barometer to rise above the mean. Mr. Forth says, in the second volume of the 'Philosophical Transactions' (Abridged), that, during a great depression of the barometer on the 8th of January, 1735, he observed that the wind in the northern parts of the island blew from the north-east, and on the southern parts of the island from the south-west. And Mr. Howard says, in a great storm of 1812 the wind on the north of the Humber blew from the east-north-east, and on the south of the Humber from the south-west. Mr. Espy then stated that he found by calculating according to well-known chemical laws, that the caloric of elasticity given out in the air in which a cloud is formed would expand the air in the cloud about 8,000 cubic feet for every cubic foot of water formed in a cloud by the condensation of the vapour; and he exhibited an instrument, which he called a Nephelescope, which enabled him to measure the expansion with great accuracy, and he found it to agree with the calculations made on chemical principles. He then proceeded to give the following outline of his theory, premising that the numbers he should introduce were not intended to be strictly accurate, and would be subject to many corrections,—one in particular, in which no notice had been taken of the specific heat of air under different pressures.

When the air near the surface of the earth becomes more heated or more highly charged with aqueous vapour, which is only five-eighths of the specific gravity of atmospheric air, its equilibrium is unstable, and up-moving columns or streams will be formed. As these columns rise, their upper parts will come under less pressure, and the air will therefore expand; as it expands, it will grow colder about one degree and a quarter for every hundred yards of its ascent, as is demonstrated by experiments on the Nephelescope. The ascending columns will carry up with them the aqueous vapour which they contain, and, if they rise high enough, the cold produced by expansion from diminished pressure will condense some of this vapour into cloud; for it is known that cloud is formed in the receiver of an air pump when the air is suddenly withdrawn. The distance or height to which the air will have to ascend before it will become cold enough to begin to form cloud, is a variable quantity, depending on the number of degrees which the dew point is below the temperature of the air: and this height may be known at any time by observing how many degrees a thin metallic tumbler of water must be cooled down below the temperature of the air before the vapour begins to condense on the outside. The highest temperature at which it will condense, which is variable accordingly as there is more or less vapour in the air, is called the "dew point," and the difference between the dew point and the temperature of the air in degrees is called the complement of the dew point.*

It is manifest, that if the air at the surface of the earth should at any time be cooled down a little below the dew point, it would form a fog, by condensing a small portion of its transparent vapour into little fine particles of water; and if it should be cooled twenty degrees below the dew point, it would condense about one-half its vapour into water, and at forty degrees below it would condense about three-fourths of its vapour into water, &c. This, however, will not be exactly the case from the cold produced by expansion in the up-moving columns; for the vapour itself grows thinner, and the dew point falls about one quarter of a degree for every hundred yards of ascent.

It follows, then, as the temperature of the air sinks about one degree and a quarter for every hundred yards of ascent, and the dew point sinks about a quarter of a degree, that as soon as the column rises as many hundred yards as the complement of the dew point contains degrees of Fahrenheit, cloud will begin to form; or, in other words, the bases of all clouds forming by the cold of diminished pressure from up-moving columns of air, will be about as many hundred yards high as the dew point in degrees is below the temperature of the air at the time. If the temperature of the ascending column should be ten degrees above that of the air through which it passes, and should rise to the height of 4,800 feet before it begins to form cloud, the whole column would then be 100 feet of air lighter than surrounding columns; and if the column should be very narrow, its velocity of upward motion would follow the laws of spouting fluids, which would be eight times the square root of 100 feet a second, that is, 80 feet a second, and the barometer in the centre of the column at its base would fall about the ninth of an inch. As soon as cloud begins to form, the caloric of elasticity of the vapour or steam is given out into the air in contact with the little particles of water formed by the condensation of the vapour. This will prevent the air in its further progress upwards from cooling so fast as it did up to that point; and, from experiments on the Nephelescope, it is found to cool only about one half as much above the base of the cloud as below—that is, about five-eighths of a degree for one hundred yards of ascent, when the dew point is about 70°. If the dew point is higher, it cools a little less, and if the dew point is lower, it cools a little more than five-eighths of a degree in ascending one hundred yards.

Now, it has been ascertained by aëronauts and travellers on mountains, that the atmosphere itself is about one degree colder for every hundred yards in height above the surface of the sea; therefore, as the air in the cloud above its base is only five-eighths of a degree colder for every hundred yards in height, it follows, that when the cloud is of great perpendicular height above its base, its top must be much warmer than the atmosphere at that height, and consequently much lighter. Indeed, the specific gravity of a cloud of any height, compared to that of the surrounding air at the same elevation, may be calculated, when the dew point is given; for its temperature is known by experiments with the Nephelescope, and the quantity of vapour condensed by the cold of diminished pressure at every point in its upward motion, and of course the quantity of caloric of elasticity given out by this condensation is known, and also the effect this caloric has in expanding the air receiving it, beyond the volume it would have if no caloric of elasticity was evolved in the condensation of the vapour. For example, according to the experiments of Prof. W. R. Johnson, of Philadelphia, a pound of steam, at the temperature of 212°, contains 1,030° of caloric of elasticity; and as the sum of the latent and sensible caloric of steam is the same at all temperatures, it follows, that a pound of steam being condensed in 1,210 pounds of water at 32° would heat this water up one degree; and, as the specific caloric of air is only 0.267, if a pound of vapour should be condensed in 1,210 pounds of air, it would heat that air nearly 4°, or, which is the same thing, it would heat 100 pounds of air about 45°. And in all these cases it would expand the air about 8,000 times the bulk of water generated; that is, 8,000 cubic feet for every cubic foot of water formed out of the condensed vapour. And as it requires between 1,300 and 1,400 cubic feet of vapour, at the ordinary temperatures of the atmosphere, to make one cubic foot of water—if this quantity be subtracted from 8,000, it will leave upwards of 6,600 cubic feet of actual expansion of the air in the cloud for every cubic foot of water generated there by condensed vapour. This great expansion of the air in the forming cloud will cause the air to spread outwards in all directions above, causing the barometer to rise on the outside of the cloud, above the mean, and to fall below the mean under the middle of the cloud as much as it is known to do in the midst of great storms. For example, if the dew point should be very high, say 78 deg., then the quantity of vapour in the air would be about one-fiftieth of its whole weight, and if the up-moving column should rise high enough to condense one-half its vapour into cloud, it would heat the air containing it 45 deg., and the air so heated would be $\frac{45}{418}$ larger than it would be if it was not so heated. And if we assume a case within the bounds of nature, and suppose the cloud and the column under the cloud to occupy three-fourths of the whole weight of the atmosphere, or in other words, if we suppose the top of the cloud to reach a height where the barometer would stand at 7½ inches, and the mean temperature of the whole column 40 deg. warmer than the surrounding air, then would the barometer fall under the cloud at the surface of the earth, $\frac{40}{418}$ of 22.5, or a little more than 2 inches. Though the air may be driven up by the ascending column much higher than the point assumed in the last article, the cloud will cease to form at greater heights, because the dew point, at these great elevations, falls by a further ascent as rapidly as the temperature—and at greater elevations, it will even fall more rapidly. If, for instance, the air should rise from where the barometer stands at 6 inches to where it stands at 3 inches, the dew point would fall about 20 deg., but the temperature would fall less than 20 deg., and therefore no vapour would be condensed by such ascent. When a cloud begins to form from an ascending column of air, it will be seen to swell out at the top while its base continues on the same level, for the air has to rise to the same height before it becomes cold enough, by diminished pressure, to begin to condense its vapour into water; this will cause the base to be flat, even after the cloud has acquired great perpendicular height, and assumed the form of a sugar-loaf. Other clouds also for many miles around, formed by other ascending columns, will assume similar appearances, and will moreover have their bases all on the same or nearly the same horizontal level; and the height of these bases from the surface of the earth, will be the greatest about 3 o'clock, when the dew point and temperature of the air are the greatest distance apart. The outspreading of the air in the upper parts of an ascending column will form an annulus all round the cloud, under which the barometer will stand above the mean; of course the air will descend in the annulus, and increase the velocity of the wind at the surface of the earth, towards the centre of the ascending column, while all round on the outside of the annulus there will be a gentle wind outwards. Any general

* The height of the bases of forming cumuli may be ascertained by the following empirical formula: $103\left(\frac{t-t'}{t'}\right)=$ height of base in 100 yards; t being the temperature of the air in degrees of Fahrenheit, and t' the temperature of wet-bulb swung briskly in the air.

currents of air, which may exist at the time, will of course modify these motions, from the oblique forces they would occasion. The up-moving current of air must of course be entirely supplied by the air within the annulus, and that which descends in the annulus itself. The rapid disturbance of equilibrium, which is produced by *one* ascending column, will tend to form *others* in its neighbourhood; for the air being pressed outwards from the annulus, or at least retarded on the windward side, will form other ascending columns, and these will form other annuli, and so the process will be continued. These ascending columns will have a tendency to approach, and finally unite; for the air between them must descend, and in descending the temperature of the whole column will increase, for it is known that the air, at great elevations, contains more caloric to the pound than the air near the surface of the earth, because it is the upper regions that receive the caloric of elasticity, given out in the condensation of vapour into clouds. Therefore, when the air has descended some time in the middle, between two ascending columns, the barometer will fall a little, or at least not stand so high above the mean as it does on the outside of the two clouds, and so the columns will be pressed towards each other. If one of two neighbouring columns should be greatly higher than the other, its annulus may overlap the smaller one, and of course the current under the smaller cloud will be inverted, and the cloud which may have been formed over the column thus forced to descend will soon disappear; for as it is forced downwards by the overlapping annulus of the more lofty column, it will come under great pressure, and its temperature will be thus increased; and it is manifest, that as soon as its top descends as low as its base, it will have entirely disappeared; and in the meantime the larger cloud will have greatly increased.

As the air above the cloud formed by an ascending column is forced upwards, if it contains much aqueous vapour, a thin film of cloud will be formed in it by the cold of diminished pressure, entirely distinct from the great dense cumulus below; but as the cumulus rises faster than the air above it, (for some of the air will roll off) the thin film and the top of the cumulus will come in contact; and sometimes a second film or cap may be formed in the same way, and perhaps a third and fourth. When these caps form, there will probably be rain, as their formation indicates a high degree of saturation in the upper air.

When the complement of the dew-point is very great, (twenty degrees and more) clouds can scarcely form; for up-moving columns will generally either come to an equilibrium with the surrounding air, or be dispersed before they rise twenty hundred yards, which they must do in this case before they form clouds. Sometimes, however, masses of air will rise high enough to form clouds; but they are generally detached from any up-moving column underneath, and of course cannot then form cumuli with flat bases; such clouds will be seen to dissolve as soon as they form, and even while forming they will generally appear ragged, thin, and irregular. Moreover, if the ground should be colder during the day, than the air in contact with it, as it sometimes happens after a very cold spell of weather, then as the air touching the cold earth will be colder than the stratum above it, ascending columns cannot exist, and of course no cumuli can be formed on that day, even though the air may be saturated with vapour to such a degree as to condense a portion of it on cold bodies at the surface of the earth. Neither can clouds form of any very great size, when there are cross currents of air sufficiently strong to break in two an ascending current, for the ascensional power of the up-moving current will thus be weakened and destroyed. This is one means contrived by nature to prevent up-moving columns from increasing until rain would follow. Without some such contrivance it is probable that every up-moving column which should begin to form cloud when the dew point is favourable, would produce rain, for as soon as cloud forms, the up-moving power is rapidly increased by the evolution of the caloric of elasticity.

On the leeward side of very lofty mountains, there cannot be rain: for as the air on the windward side rises up the sides of the mountain, it will condense all the vapour which can be condensed by the cold of diminished pressure, before it reaches to the top, and even if cloud passes over the top to the other side, it would soon disappear, because in passing down the slope it will come under greater pressure, and thus be dissolved by the heat produced. These are some of the causes which prevent rains at particular times and in particular localities. If, however, the air is very hot below, with a high dew point, and no cross currents of air above to a great height, then, when an up-moving current is once formed, it will go on and increase in violence as it acquires perpendicular elevation, especially after the cloud begins to form. At first the base of the cloud will be flat; but after the cloud becomes of great perpendicular diameter, and the barometer begins to fall considerably, as it will do from the specific levity of the air in the cloud, then the air will not have to rise so far as it did at the moment when the cloud began to form, before it reaches high enough to form cloud from the cold of diminished pressure. The cloud will now be convex below, and its upper parts will be seen spreading outward in all directions, especially on that side towards which the upper current is moving, assuming something of the shape of a mushroom. In the meantime, the action of the in-moving current below, and up-moving current in the middle, will become very violent, and if the barometer falls two inches under the centre of the cloud, the air will cool about ten degrees, and the base of the cloud will reach the earth if the dew point was only 8° below the temperature of the air at the time the cloud began to form. The shape of the lower part of the cloud will now be that of an inverted cone with its apex on the ground; and it will be what is called a tornado, if it is on land, and a waterspout if at sea.

On visiting the path of a tornado, the trees on the extreme borders will all be found prostrated with their tops inwards, either inwards and backwards, or inwards and forwards, or exactly transverse to the path. The trees in the centre of the path will be thrown either backwards or forwards, or parallel to the path; and invariably if one tree lies across another, the one which is thrown backwards is underneath. Those materials on the sides which are moved from their places and rolled along the ground, leaving a trace of their motion, will move in a curve convex behind, those which were on the left hand of the path will make a curve from left hand to right, and those on the left hand of the path will make a curve from right hand to left; and many of these materials will be found on the opposite side of the path from that on which they stood on the approach of the tornado. Also those bodies which are carried up will appear to whirl, unless they arise from the very centre—those that are taken up on the right of the centre will whirl in a spiral from left to right, and those on the left of the centre will whirl in a spiral upwards from right to left. On examining the trees which stand near the borders of the path, it will be found that many of the limbs are twisted round the trees, and broken in such a manner as to remain twisted, those on the right hand side of the path, from left to right, and those on the left hand side of the path from right to left. However, it will be found that only those limbs which grew on the side of the tree most distant from the path of the tornado are broken; for these alone were subject to a transverse strain. The houses which stood near the middle of the path will be very liable to have the roof blown up, and many of the walls will be prostrated, all outwards, by the explosive influence of the air within, and those houses covered with zinc or tin, from being air tight, will suffer most. The floors from the cellars will also frequently be thrown up, and the corks of empty bottles exploded. All round the tornado at a short distance, probably not more than three or four hundred yards, there will be a dead calm, on account of the annulus formed by the rapid efflux of air above, from the centre of the up-moving and expanding column. In this annulus the air will be depressed, and all round on the outside of it, at the surface of the earth, there will be a gentle wind outwards, and of course all the air which feeds the tornado is supplied from within the annulus. Nor is this difficult to understand, when the depression of the air in the annulus is considered, for any amount may be thus supplied by a great depression. Light bodies, such as shingles, branches of trees, and drops of rain or water formed in the cloud, will be carried up to a great height, before they are permitted to fall to the earth; for though they may frequently be thrown outwards above, and then descend to a considerable distance at the side, they will meet with an in-blowing current below, which will force them back to the centre of the up-moving current, and so they will be carried aloft again.

The drops of rain, however, will frequently be carried high enough to freeze them, especially if they are thrown out above so far as to fall into clear air, for this air will in some cases be thirty or forty degrees colder than the air in the cloud. In this case, if the up-moving column is perpendicular, the hail will be thrown out on both sides; and on examination it will be found that two veins of hail fell simultaneously, at no great distance apart. It is indeed probable, that in all violent thunder storms in which hail falls, the up-moving current is so violent as to carry drops of rain to a great height, when they freeze and become hail. It is difficult, if not impossible, to conceive any other way in which hail can be formed in the summer, or in the torrid zone. In those countries in which an upper current of air prevails in a particular direction, the tornadoes and waterspouts will generally move in the same direction, because the up-moving column of air in this meteor rises far into this upper current, and of course its upper part will be pressed in this direction, as the great tornado cloud moves on in the direction of the upper current, the air at the surface of the earth will be pressed up into it by the superior weight of the surrounding air. It is for this reason that the tornado in Pennsylvania generally moves towards the eastward.

If a tornado should stop its motion for a few seconds, as it might do, on meeting with a mountain, it would be likely to pour down an immense flood of water or ice, in a very small space, for the drops which would be carried up by the ascending current would soon accumulate to such a degree as to force their way back, and this they could not do without collecting into one united stream of immense length and weight, and of course on reaching the side of the mountain, this stream, whether it consisted of water or hail, would cut down into the side of the mountain a deep hole, and make a gully all the way to the bottom of the mountain, from the place where it first struck.

As the air spreads out more rapidly above than it runs in below, there will be a tendency in storms to increase in diameter, and this tendency will be greater on the north side than on any other, for the air in its efflux above finds less resistance on that side, for a reason assigned in the next paragraph; therefore it is probable that storms become elongated north and south, and then, if they move towards the east, they must travel side foremost.

At the equator, or at least those parts of it where the trade winds are constant from east to west, it is probable tornadoes travel from east to west. For as the air in the torrid zone is about 80° in temperature at a mean, and the air in the frigid zone is about zero, the air in the torrid zone is constantly expanded by heat about 80.448 of its whole bulk in the frigid zone. This will cause the air at the equator to stand more than seven miles higher from the surface of the earth to the top of the atmosphere than at the north pole. The air therefore will roll off from the torrid zone both ways towards the poles, causing the barometer to fall in low latitudes, and rise above the mean in high latitudes. This will cause the air to run in below towards the equator, and of course rise there. Now from the principle of the conservation of areas, it will fall more and more to the west as it rises, and of course the upper current of the air, at the equator, probably moves towards the west. However, as the air rolls off above, towards the north, it will be constantly passing over portions of the earth's surface, which have a less diurnal velocity than the part from which it set out, and as from the nature of inertia it still inclines to retain the diurnal velocity towards the east, which it originally possessed, when it reaches the latitude of about 20 or 25 degrees, it will then probably be moving nearly towards the north, and beyond that latitude its motion will be north-easterly.

If violent storm clouds, which necessarily rise to a great height into the upper current, are driven forward in the direction of the upper current, it is probable that the barometer will rise higher in that part of the annulus which is in front of the storm, than in the rear, and if so, a sudden rise of the barometer, in particular localities, may become, when properly un-

derstood, one of the first symptoms of an approaching storm. In consequence of the high barometer in front of the storm in a semiannulus, the air will be forced downwards there, and cause, in some cases, a more violent action of the air or wind backwards, meeting the approaching storm, than will be experienced in the rear of the storm. As the barometer will probably be highest in the centre of the semiannulus, north-east of the storm, in middle latitudes, the tendency of the wind to blow outwards on all sides from the centre, may cause the wind in the beginning of the storm to blow so as to appear to whirl from left to right, on the east side of the storm, and from right to left on the west side.

As the air comes downwards in the semiannulus in front of the storm, it will come under greater pressure, and therefore any clouds which it may contain will probably be dissolved by the heat of greater pressure, and therefore on the passage of the annulus it will probably be fair weather. Also, as the air above always contains more caloric to the pound than the air below, there will be an increase of temperature on the passage of the annulus, partly from the increased pressure, but chiefly by the descent of the air. In very hot climates, this increase of temperature in front of the storm will be very sensibly felt. The increased pressure in the annulus round a volcano, when it suddenly bursts out, will sometimes, under favourable circumstances, be very great, and of course the air will be depressed from a great height; so that some portion of the very air which has gone up in the central parts of the ascending column, and formed cloud by the cold of diminished pressure, will be forced down to the surface of the earth, bringing with it the caloric of elasticity which it received from the condensing vapour—if so, the heat experienced at the time of this descent will be very great.

These hot blasts of air will alternate with cold blasts; for the air which is forced down from great heights in the annulus will not only be very hot, but very dry, having condensed its vapour in its previous ascent. Now, when this hot dry air flows inwards again towards the volcano, and ascends, it will not form cloud, because of its want of vapour, and therefore the process of cloud-forming will cease, and consequently hail and rain will cease too, until more air from a greater distance, that has not been deprived of its vapour, flows in and ascends. Then cloud will again begin to form, and the violence and rapidity of the outflowing of the air above will be increased by the evolution of the caloric of elasticity,—the barometer will rise rapidly in the annulus, and fall in the central part of the ascending column; and these alternations may continue while the volcano is in activity, more particularly if the violence of the volcano itself should be increased periodically.

As air cannot move upwards without coming under diminished pressure, and as it must thus expand and grow cooler, and consequently form cloud, any cause which produces an up-moving column of air, whether that cause be natural or artificial, will produce rain, when the complement of the dew point is small, and the air calm below and above, and the upper part of the atmosphere of its ordinary temperature.

Volcanoes, therefore, under favourable circumstances, will produce rain—sea-breezes, which blow inwards every day towards the centre of islands, especially if these islands have in them high mountains, which will prevent any upper current of air from bending the up-moving current of air out of the perpendicular, before it rises high enough to form cloud, such as Jamaica, will produce rain every day—great cities where very much fuel is burnt, in countries where the complement of the dew point is small, such as Manchester and Liverpool, will frequently produce rain—even battles, and accidental fires, if they occur under favourable circumstances, may sometimes be followed by rain. Let all these favourable circumstances be watched for in time of drought (and they can only occur then), and let the experiment be tried; if it should be successful, the result would be highly beneficial to mankind. It might probably prevent the occurrence of those destructive tornadoes which produce such devastation in the United States; for if rains should be produced at regular intervals, of no great duration, the steam power in the air might thus be prevented from rising high enough to produce any storm of destructive character. Independently of its utility to the farmer, it would be highly useful to the mariner in the following way:—As the very time and place of the commencement of the rain would be known, it would be easy to find out in what direction from the place of beginning it moved along the surface of the earth, and also its velocity of motion, and the shape that it assumed from time to time in its progress. Now this knowledge is the principal thing wanting to enable the mariner, who has the power of locomotion, to direct his vessel so, when one of these great storms comes near him, as to use as much wind in the borders of the storm as will suit the purposes of navigation—for heaven undoubtedly makes the wind blow for his use, and not for his destruction, provided he becomes acquainted with the laws to which it is subject. From the preceding principles, he will be able to know in what direction a great storm is raging when it is yet several hundred miles from him, for the direction of the wind alone points it out. If, however, the storm should be of such great length, moving side foremost, as to preclude the possibility of avoiding it, he will at least be enabled to know in what direction to steer his ship, so as to get out of the storm as soon as possible. For example, if it shall be found that storms between the United States and Europe always move towards the east, then it will manifestly be improper to scud with the wind in the latter part of the gale, when the wind is blowing from the westward, because this would be to keep in the storm as long as possible. The sailor also will be able to know when he is out of danger; for when a great storm has passed off to the east in middle and high latitudes, and to the north in low latitudes, on the north of the equator, he will know that it never returns; and therefore he will not be afraid to spread his sails to the wind, before the calm of the annulus comes upon him. The mariner will finally be able, by observing storm clouds on their approach, to ascertain the direction in which storms move; for these storm clouds frequently exhibit themselves above the horizon in the form of an arch; and if the highest part of the arch approaches towards the zenith, then is the storm coming from the point where the arch first appeared.

When a storm has a much greater diameter from north to south, than from east to west, the wind will not blow towards a central *point*, but towards a central *line*, which may be called the major axis of the storm.

On the northern end of the storm, if it moves towards the east, the wind will change round *without* a lull, by north towards the west—and on the southern end of the storm, the wind will change round *without* a lull, by south towards the west; but in the middle of the storm the wind will change *with* a lull from easterly to westerly.

When the storm is of great length, north and south, the lull in the central parts may be experienced simultaneously, at considerable distances apart, north and south, which could not be the case if the storm was round;—and as this occurs frequently on the coast of the United States, it is certain, from that circumstance alone, that the centre of storms is frequently a line of great length; and moreover, as the wind in the first part of the storm is frequently S.E., and in the last part of the storm N.W.; and as the barometer falls successively from north of west to south of east, it seems highly probable that these storms of oblong form move towards the south of east.

In the West Indies, from Barbadoes to Jamaica, it is known, by the invaluable labours of Redfield and Reid, that the hurricanes there move from the S.E. to N.W.; therefore, if the wind springs up violent from north-west in those parts, the mariner may be sure that a hurricane is coming upon him if he remains stationary; and if it springs up in any other direction, he will know in what direction to sail to avoid its violence.

This paper gave rise to a very interesting conversation, but from the great length of the paper itself, we can only direct attention to the leading points of the discussion. Prof. STEVELLY called the attention of the Section to the fact that he had, at the Edinburgh meeting in 1834, used the principle of cold, produced by rarefaction, to explain what he called the secondary formation of clouds, and thus the *propagation of storms*: and even assigned this rarefaction as the cause of summer hail (see *Athen.* No. 361, 1834). He objected to the main position, however, in Mr. Espy's theory, that *the fall of temperature* caused by the expansion of any body of air rendered light, by being loaded with moisture as it rose in the atmosphere, was the same as the *constituent temperature of the strata of air* into which it rose, that is, of equal tension. He deduced from the numbers given by Poisson, that it was much greater; that a cloud would be colder and not hotter than the surrounding air, and therefore the violent ascending vortex calculated upon by Mr. Espy would not exist.—Prof. FORBES had three objections to Mr. Espy's theory, 1st, the small funnel at the centre of a tornado, through which Mr. Espy supposed the air to rise, would be insufficient to vent all the air which would rush during a tornado, with the frightful velocity we know it to attain, through the constantly enlarging rings surrounding that central funnel, to an extent of many hundred miles; 2nd, as the tornado had a progressive motion, as Mr. Espy admitted, it would be more difficult than Mr. Espy supposed to deduce from the way in which the trees in its path were thrown, the actual course of the atmospheric particles at any instant, as each would move with a motion compounded of two motions, both varying in relative direction and magnitude; 3rd, he thought that all the vapour in the air would be condensed into cloud much sooner than Mr. Espy supposed, and he thought it certain that the small amount of heat given out by the vapour would not suffice to expand the air in the funnel to the extent required, if Mr. Espy's views were correct.—As to the question whether Mr. Redfield and Col. Reid's theory of a whirl, or Mr. Espy's radial theory, was most accordant with fact, Mr. OSLER said, that from the investigation he had given this subject, he was convinced that the centripetal action described by Mr. Espy took place in most hurricanes. The particulars he, Mr. Osler, had collected, together with the indications obtained from the anemometers at Birmingham and Plymouth, satisfied him that the action of the great storm of the 6th and 7th of Jan. 1839, was not rotatory at the surface of the earth when it passed across England. He differed, however, both from Mr. Espy and Mr. Redfield in one essential point, for he believed it would be almost impossible to have a violent hurricane without, at the same time, having both rotatory and centripetal action. A storm might very probably be generated in the first instance, in the manner accounted for by Mr. Espy, or by the action of contrary currents: in the first case the rush of air towards a spot of greater or less diameter, would not be perfectly uniform, owing to the varying state of the surrounding atmosphere; this, together with the upward tendency of the current would, in some cases, produce a violent eddy or rotatory motion, and a whirlwind of a diameter varying with the cause would ensue; the centripetal action would thus be immensely increased, the *whirlwind itself* demanding a vast supply of air, which would be constantly thrown off spirally upwards, and diffused over the upper atmosphere, thus causing the high state of the barometer which surrounds a storm. He further stated, that he had brought his theory of the combined action of centripetal and rotatory motion before the meeting of this Association at Birmingham, and a short notice of it would be found in the reports of the Sections. If no rotatory action takes place, he believed that we merely experienced the rush of air which necessarily precedes a heavy fall of rain or thunder storm, but he believed that nothing violent enough to be called a hurricane could take place, unless a violent rotatory or whirling action be first produced, and that in many and perhaps most cases, the rotatory portion is not in contact with the earth.—Mr. ARCH. SMITH said, there was one point which must not be overlooked in any correct comparison of the rival theories. From the principle of the conservation of areas it was perfectly certain, that if a storm was caused in the manner supposed by Mr. Espy, there must be a rotation, greater or less, in the centre. Because, unless the motion of all the currents was accurately directed to one point, or at least their *moments* in a horizontal plane were equal to zero, which was infinitely improbable, a motion of rotation must be the result, as in the instance of the motion of water in a funnel, cited by Mr. Espy. If the central space of comparative rest were large, the whirl might be imperceptible; but if small, as in the case of a waterspout, it must

be considerable. Without embracing either theory, he thought it difficult to conceive, as he understood Mr. Osler to do, the motion of rotation to be the primary, and the centripetal (which indeed would be centrifugal) force to be the secondary phenomenon. But it was comparatively easy to suppose the centripetal motion to be the primary phenomenon, and quite certain that if so, there must result a secondary phenomenon of rotation, of which indeed some indications appeared in Mr. Espy's maps.—In making some remarks on the preceding paper, Sir David Brewster observed, that it was impossible to form any decided opinion on the subject, from the great want of well ascertained facts; and as Mr. Espy had founded his theory expressly on observations, often made by himself, it was impossible to do justice to his ingenious views until a greater number of facts had been collected. The facts, too, stated by Mr. Espy were opposed to those observed by others. In the case of hurricanes or tornadoes the convergency of the aërial currents in the one theory, and their rotatory motion in the other, were not *observed*, but *inferred* from a number of facts; but as Mr. Espy regarded waterspouts as formed in the same manner as tornadoes, and as Colonel Reid had distinctly stated in his letter to Sir David, already referred to, that he had *actually seen*, from the government house at Bermuda, by means of a telescope, the *waterspout revolving like the hands on the dial-plate of a watch*, there could be no doubt that we were at variance about facts. This explicit and distinct *observation* of a rotatory motion, by so able and accurate an observer as Col. Reid, was worth a thousand inferences.—Prof. Phillips must say that he thought the statements of fact connected with tornadoes, as stated in the American journals, were more consistent with Mr. Espy's than with Mr. Redfield's theory; and Col. Reid thinking he saw rotation in a waterspout could not invalidate the abiding evidence from uprooted forests.—Mr. Espy in his reply seemed to think he had been misunderstood, and answered Prof. Forbes's objections at considerable length.

Section B.—CHEMISTRY AND MINERALOGY.

MONDAY.

The first paper read was by Mr. Mallet 'On the Action of Salt and Fresh Water on Cast and Wrought Iron and Steel.'—It constituted a continuation of his report presented two years ago; but as the paper was also read in Section G, we refer the reader to our report, p. 804.

Mr. J. J. Griffin read a paper 'On a New Method of Crystallographic Notation.'—The author classes the planes of crystals into seven elementary sets, which he calls "Forms." The planes of crystallized minerals consist of these forms in various states of combination. Hence a natural crystal, speaking crystallographically, is a "combination." The seven fundamental forms are named P, M, T, MT, PM, PT, PMT. These symbols show the relation of the planes which constitute the forms to what are termed the axes of a crystal. These axes are three mathematical lines which cross one another in the centre of the crystal at an angle of 90°. The position of the first of these axes is perpendicular, whence it is called the principal or perpendicular axis, and is denoted by the sign p^a. The second axis is called the minor or middle axis, and is denoted by the sign m^a. It passes from the front to the back of the crystal. The third axis is the transverse axis. It passes from the left to the right side of the crystal, and is denoted by the sign t^a. All the planes of a crystal, when extended, cut one or two or three of these axes, and they are denoted by letters referring to the axes which they cut. Thus, P means two planes that cut p^a; M, two planes that cut m^a; T, two planes that cut t^a; MT, four planes that cut m^a and t^a; PM, four planes that cut p^a and m^a; PT, four planes that cut p^a and t^a; PMT, eight planes that cut all the three axes. When the axes are cut at different distances from the centre of the crystal, the lengths of the respective axes are indicated by indices placed between the letters which constitute the symbol of the form. Thus, $M\frac{1}{2}T$ denotes a vertical rhombic prism, the diagonals of whose cross section are as the numbers 1 and 2; and $P\frac{3}{2}M\frac{1}{2}T$ denotes a rhombic octahedron, whose three axes have the relation of $p\frac{a}{3}m\frac{a}{1}t\frac{a}{2}$. Mr. Griffin entered into various details to prove that the occurrence of planes, not representable by one or other of these seven forms, was a mathematical impossibility, and that the proposed system of notation was amply sufficient for all the purposes of the chemist and mineralogist, while it had over other systems of crystallography the advantage of requiring but a small amount of mathematical knowledge.

'On the action of Nitric Acid on the Chlorates, Iodates, and Bromates of Potassa and Soda,' by Prof. F. Penny.

The present communication contains the details and results of some experiments undertaken with the view of obtaining additional confirmation of the correctness of the author's researches on equivalent numbers. In this he has been disappointed, as the action is attended by circumstances which render it inapplicable to so delicate a purpose as the determination of equivalent numbers. The results, however, that he has obtained are new, and he considered them of sufficient interest to be worthy the attention of the Section. In order to examine the action of nitric acid upon chlorate of potassa, a known weight of the salt was mixed in a retort with a measured quantity of the acid, and the mixture heated on a sand bath; as soon as it became warm, chlorine and oxygen were evolved in a state of mixture and not of combination, and the chlorate slowly disappeared. The solution was then evaporated to dryness, and the saline residue was found to be a mixture of hyperchlorate and nitrate of potassa, in the proportion of three equivalents of the latter to one of the former. The author expresses the reaction that takes place as follows:—

$4(K+Cl+O_6)$ and $3(N+O_5)=(K+Cl+O_8)$ and $3(K+N+O_6)$ and Cl_3 and O_{13}.

The action of nitric acid on chlorate of potassa differs, then, from the action of sulphuric acid on the same salt. With nitric acid the salt is decomposed tranquilly, and the chlorine and oxygen liberated uncombined, whereas with sulphuric acid these gases are evolved in a state of combination, forming that dangerously explosive compound, chlorous acid. Nitric acid is therefore to be preferred for the preparation of hyper-chlorate of potassa, as with it the operation may be conducted without those violent detonations that are so apt to occur with sulphuric acid. The action of nitric acid on chlorate of soda is the same as upon chlorate of potassa. The chlorine and oxygen set free are in a state of mixture, and every 4 atoms of chlorate yield 3 of nitrate and 1 of hyper-chlorate. The hyper-chlorate of soda is a very soluble salt, and crystallizes in small rhombs. It is readily decomposed by heat, but is unacted upon by hydrochloric acid. It deliquesces by exposure to the air. The action of nitric acid on an iodate is very different from that on a chlorate, and is well illustrated in the case of iodate of potassa. When iodate of potassa is boiled for some time with a large excess of nitric acid, it is decomposed into potassa and iodic acid, the potassa combines with its proportionate quantity of nitric acid, forming the nitrate, and the iodic acid is deposited from the solution in minute, hard, and transparent crystals. If the acid solution of nitre, containing the iodic acid, be then evaporated, a re-action takes place; the iodic acid decomposes half of the nitre, sets free its nitric acid, and combines with the potassa, forming the biniodate. This change is completed when the mixture is dry, and if the heat be then withdrawn a definite mixture of biniodate and nitrate is obtained. If the heat be continued, a still further change occurs, the iodic acid expels the whole of the nitric acid, which is evolved as nitrous acid, and oxygen and neutral iodate of potassa remain. By adding a fresh portion of nitric acid to this iodate, the same changes may be produced by a proper regulation of the temperature. By acting upon iodate of soda with nitric acid, Prof. Penny has obtained a biniodate of soda, and by adding a considerable excess of iodic acid to a solution of iodate of soda he has found a teriodate of soda. Both of these salts are anhydrous. The biniodate of potassa contains one atom of water. He also finds that crystals of iodate of soda contain different quantities of water, according to the strength of the solution from which they have deposited. From a hot and strong solution this salt crystallizes in acicular tufts, and these crystals contain two atoms of water. If the solution be rather weak, long four-sided prisms are obtained, and these contain 6 atoms of water. If a solution of iodate of soda be evaporated spontaneously, large irregular prisms deposit, and these contain 10 atoms of water. They effloresce rapidly by exposure to the air, and lose in this way 8 atoms of water. The action of nitric acid upon bromate of potassa was next examined, and was found to differ remarkably from the actions of this acid on the chlorate and iodate. Neither hyper-bromate nor bibromate is produced, but merely nitrate of potassa. The nitric acid sets free the whole of the bromic acid, and this, at the moment of its liberation, is resolved into its elements, bromine and oxygen. In conclusion, the author remarks that the action of nitric acid on these three classes of salts affords a ready method of distinguishing them from one another.

'On the tests for Sulphuric Acid when thrown on the Person,' by R. D. Thomson, M.D.

The object of the author was to discuss the accuracy of the modes of testing sulphuric acid when employed for criminal purposes, and especially when thrown on the person. A case had lately occurred to him in practice, and which was brought before the last session of the Central Criminal Court, which proved that the mode of determining the presence of *free* acid by *mere* testing was by no means satisfactory. A woman in a fit of rage threw a quantity of oil of vitriol at the face of a cab-master in the neighbourhood of Euston Square, and before the unfortunate sufferer could wash off the acid two minutes had expired; the consequence was, loss of vision in the eye. The author stated, that having attentively considered this case, and made a series of experiments on the eyes of dead animals, he had discovered that this kind of blindness was perfectly curable, and he had accordingly proposed an operation for this purpose in a paper read at the Medical Section. But besides having his face injured, the hat of the man was discoloured also by the acid. This article of dress was sent to the author, to determine the nature of the agent in this work of destruction. The result of his experiments was, that the injured hat, as well as an uninjured one, contained sulphuric acid, as tested by nitrate of barytes, and a solution of the soluble matter of both states of this article of dress afforded an acid reaction. It was therefore necessary to adopt some method which would afford a discriminatory test between the free and combined acid; the usual mode, viz. by boiling with carbonate of lead, and concluding, if any insoluble sulphate of lead was formed, that the acid existed in a free state, was found to be totally fallacious, because carbonate of lead decomposes sulphate of soda, contrary to the opinion stated in works of medical jurisprudence. Besides, it was shown that many of the usually so called neutral sulphates exhibit, in reality, an acid reaction upon test-paper, as in the instances generally of sulphates of potash, iron, soda, barytes, and also in the cases of alum, &c.; and hence the excess of acid attached to these salts would be apt to act as free acid upon the barytes test. The author, therefore, concludes, that the only demonstrative proof which chemistry affords is a quantitative analysis. Thus he found the entire hat to contain .356 per cent. of sulphuric acid, probably in the state of alum or copperas, and the injured hat 1.379 per cent.; or, in other words, the hat had received by the injury 1.023 per cent. of free sulphuric acid. Here there was afforded clear evidence of the nature of the agent employed to effect the injurious object, which could not have been conclusive if the matter examined had only amounted to a drop or a stain. The author directed attention to a point connected with sulphuric acid in a medico-legal point of view, viz. that the oil of vitriol of commerce always contains, in this country, nitric acid, in addition to various other impurities. Barruel has stated, that sulphuric acid is capable of dissolving platinum. The author has not been able to satisfy himself that it dissolves any sensible quantity of gold leaf. Barruel attributes the property, which he states it to possess, of dissolving platinum, to the sulphuric acid assuming the function of muriatic acid. But the author is not aware of any experiment which would authorize this conclusion. He is rather inclined to attribute the action, if such an occurrence takes place, to the muriatic acid which is present in all the oil of vitriol prepared from sulphur that he has examined. It is given out in sensible quantities when a solid oil, such as cocoa nut oil, is

acted on by sulphuric acid. This he ascertained several years ago, when examining some Indian oils, and Dr. Kane has since corroborated the fact of the existence of muriatic acid in oil of vitriol, although the author has not been able to observe the solution of any sensible quantity of gold leaf by the action of oil of vitriol *per se*; yet if a few drops of muriatic acid be added, the action becomes very powerful, and by the application of heat platinum also is dissolved. These facts, therefore, prove that whenever we have oil of vitriol we may expect also nitric acid. The author added, that he knew of no certain mode of detecting the presence of nitric acid save by the property which it possessed of dissolving gold and platinum by the addition of muriatic acid. Pure morphia has no action upon nitric acid. It is the resin which generally accompanies that alkaloid which produces the characteristic yellow colour. But the author found that preparations of opium in which the resin was excluded, afforded no colour when nitric acid was added. From an examination of numerous cases of poisoning by opium which had appeared before the Middlesex coroners, he had come to the conclusion that the resin-of-opium test for nitric acid, afforded only an auxiliary method of arriving at the truth, as its characters were frequently usurped by other organic substances.

Prof. JOHNSTON 'On the Resin of Sarcocolla.'

The resin of sarcocolla of commerce is separated by water into three portions: 1. A gum (A) which does not dissolve in water or alcohol, but which is in a great measure washed out by means of the former solvent. 2. A portion (B) insoluble in water, but soluble in alcohol, which is of a resinous aspect, and is represented by $C_{40}H_{32}O_{14}$. The hydrate is $C_{40}H_{32}O_{14}+3HO$ when dried at 60°. This portion B, is separated (decomposed?) by bases into two or more organic compounds, the alcoholic solution giving with neutral acetate of lead a salt containing an organic constituent represented by $C_{40}H_{25}O_{16}$. Ammonia throws down from the mixed solutions a second salt of lead, the constitution of the organic constituent in which has not yet been determined. 3. The portion taken up by water from the crude sarcocolla, when evaporated to dryness, is separated by alcohol or ether into a soluble (C) and an insoluble portion (D). 4. The soluble portion C dried at 212, gave discordant results approaching to $C_{40}H_{22}O_{15}$, but when treated with bases gave salts containing organic constituents of a different constitution. A neutral acetate of lead throws down a salt represented by $P6O+C_{40}H_{28}O_{15}$, and the subsequent addition of the neutral *tris*-acetate a salt represented by $2P6O+C_{40}H_{32}O_{16}$. 5. The portion D, insoluble in alcohol, but soluble in water, consists of a gum and of a substance which is precipitated by neutral acetate of lead in curdy flocks. The investigation is still in progress, and the results are to be considered as open to correction.

SECTION C.—GEOLOGY AND PHYSICAL GEOGRAPHY.

SATURDAY.

G. B. Greenough, Esq. in the chair.

Mr. BALD read a paper 'On the Value of Topographical Maps and Models,' and exhibited his Map of the County of Mayo, in Ireland.

This map is on the scale of two inches to a mile, and represents the remarkable physical features of that region; the levels of the mountains, hills, lakes, plains, &c. are all given, both barometrically and trigonometrically, and at the foot of the map is a vertical section of the country from east to west, describing its geological structure, besides various views, profiles, &c. Accompanying the map was a model of seven feet six inches by five feet, on the scale of four inches to a mile. In the course of his paper, Mr. Bald gave an account of the various methods of modelling, and strongly recommended their more general use, as giving a better idea of the country than can any other mode.

Mr. FEATHERSTONHAUGH stated, that in the recent examination of the boundary line of Maine and New Brunswick, by himself and Col. Mudge, he had used twelve mountain barometers by Bunten, of Paris, which he preferred to all others.—Capt. WASHINGTON contended, that for all practical purposes the barometers of Newman, of London, were fully equal to, if not superior to the syphon barometer of Bunten, in which it was difficult to read off the lower vernier with accuracy.—Mr. Featherstonhaugh admitted, that latterly in completing the survey, four of Newman's barometers had been used, and had given satisfaction.

'Additional Notes on the Wadi el 'Arabah, in Syria,' by the Rev. Dr. E. Robinson, of New York.

The interest attached to that very remarkable fact in physical geography, which has not yet been cleared up,—namely, the depression of the surface of the Dead Sea, said to vary from 600 to 1,400 feet (according to different measurements) below the level of the Mediterranean and the drainage, probably dependent upon this depression, of a large tract of country including numerous lateral valleys, extending to the southward for upwards of 100 miles through the district termed Arabia Petræa, from the south point of the Dead Sea nearly to the Gulf of Akabah,—induces me to offer a few words on the line of separation of waters between these two basins, which may be termed a postscript to some remarks I formerly had occasion to make on M. de Bertou's account of his journey in 1838 through the Wadi el 'Arabah, from the Asphaltic lake to the Elanitic gulf (*Athen.* No. 653). At that time I took it for granted that the Wadi Talha of Bertou (according to his own map) was identical with the great Wadi Jerafeh, with which we had become acquainted while travelling through the western desert to Hebron, and, again, as seen from the pass of Nemela, north of Mount Hor. But on a careful reconstruction of Bertou's itinerary by M. Kiepert, of Berlin, it appears that his Wadi Talha must be situated about two hours south of the Jerafeh, and has no connexion whatever with the latter. It would seem, therefore, to be the Wadi Abu Talha of Burckhardt. The effect of this is to move the place of the watershed, as specified by Bertou, to a point some six miles farther south than I had supposed him to mean; and if this correction be well founded, it follows that the traveller passed before, and probably across the mouth of the Jerafeh, without noticing it; although this is the great drain of all the adjacent parts of the western desert, and one of the most important and remarkable features of the whole region.

In connexion with Dr. Robinson's recent travels through Palestine, Capt. Washington exhibited a newly-constructed plan of the city of Jerusalem, correcting many former inaccuracies, pointing out several ancient sites, and showing the shading of the hills within the city, a feature not represented on any former plan.

'Some Observations on Relief Maps,' by Mr. A. Ravenstein, of Frankfort.

The obvious advantages of maps stamped in relief for representing the great physical features of a country, and the probability that such maps will soon be very extensively used, induces me to offer a few words in reply to a request I have received, to state my opinion on the relief maps of M. Kummer, of Berlin. With regard to their invention, I must claim to have been the first who introduced the method of raising the hills, by means of the press or stamping, as may be seen by my 'Plastic Atlas,' published in 1838; it would be unjust, therefore, to attribute to Berlin that which was first made at Frankfort. It must be observed, that these are quite distinct from M. Kummer's 'Globe en relief,' published some years since, as that was made of papier mâché. M. Bauerkeller, of Paris, also made public, in 1839, his 'Environs de Paris,' in the stamped relief method, with the difference, however, that the colours are put in after the Congreve manner. In the preface to my Plastic Atlas, I anticipated that great improvements would be made; and it is due to M. Kummer to state, that he has so far succeeded, as to lead me to hope that these maps will shortly reach still greater perfection, and, when made on a large scale, will come into general use, and supersede all other maps,—and especially physico-geographical maps, without reference to political divisions; and I feel that I do but express the feeling of all interested in the advancement of physical geography, by saying that I heartily hope that M. Kummer will persevere in his efforts.

These observations were illustrated by M. Ravenstein's 'Plastic Atlas,' several stamped maps by Kummer, of Berlin, and a specimen of Bauerkeller's stamped and coloured plan of the city of Frankfort. In making some remarks on these maps, Capt. Washington stated, that in the course of a recent visit to Germany, to complete the collection belonging to the Geographical Society of London, he had been much gratified by the maps published at the topographical establishments at Vienna and Dresden; also by the models in relief of the Taunus Mountains and the Siebengebirge, as well as by a relief map of the Rhine, from Mainz to Bonn, by M. Ravenstein, of Frankfort.

A letter was read from the Rev. Mr. Selvester, who had resided above fifty years in the Faroe Islands, expressing an opinion that the level of the coast had there undergone a depression. This was inferred from encroachments made by the sea at several points, and particularly from the fact, that on the 6th of January, 1828, fully two-thirds of the sun's orb had been visible above a hill near his house from the same spot where, in 1801, he had only been able to see the upper edge of the disc.

Capt. WASHINGTON suggested that this effect might probably be accounted for by refraction; but Mr. Trevelyan conceived that its steady occurrence, and similar observations in other quarters, gave room to infer an actual change of level.—Mr. YATES and Mr. GREENOUGH observed, that the fact, if it really existed, was very important, and that further and careful observation on the subject was desirable.

'Observations on Great Earthquakes on the West Coast of South America, particularly the great one of the 18th of September 1833, which destroyed the City of Tacna, and other places in Peru,' by Mr. Mathie Hamilton.

Tacna, an Indian town of some antiquity, now capital of the province of the same name, lies in the midst of a desert tract of about 50 miles broad, between the mountains and the sea. The port of Arica, about 40 miles distant, had, since the first arrival of the Spaniards, been five times destroyed by earthquake, while Tacna had enjoyed a happy immunity, and was supposed beyond the reach of this calamitous visitation. After 1826, however, very frequent and severe shocks were felt, particularly a few weeks before the great one of the 8th of October 1831, which reduced Arica to a heap of rubbish; yet it continued nearly uninjured till the evening of the 16th of September 1833, when there occurred a single loud report, with an upward movement of the ground. On the morning of the 18th, there was a much more violent movement, the earth heaving at once up and down, and also laterally, accompanied by a frightful subterranean noise. The falling of houses all around, the cries of the people, the howlings of animals, produced a scene that cannot be described. The agitation seemed to have reached the utmost possible height, when suddenly the earth, as if striving to get rid of some mighty load, made a more terrible movement than ever, in every direction, and in one minute, the work of destruction was completed. The cathedral in falling destroyed a numerous congregation of females, who had assembled there, and were endeavouring to escape; but the priests, who remained under an arch, were saved. It is remarkable, that while some quarters had nearly every house demolished, others were comparatively uninjured. This great movement was succeeded by a series of slight shocks, which continued during many days. Rain (here a phenomenon,) fell almost every day during six weeks; and at Arica, on the first week of October, there came down a deluge, such as had not been witnessed for half a century. The river which supplies Tacna with water, remained undisturbed; but others were changed in their courses, and one altogether disappeared. The earthquake was felt many hundred miles to the south, as far as the Desert of Atacama. At Suto, about 40 miles distant, fissures were made in the ground, whence issued a dark-coloured fluid. In the province of Tarapaca, villages were overthrown, and one, which stood in a ravine, was buried, with all its inhabitants. To the north, its ravages were equally extensive. The villages of Samo, distant 30 miles, and of Coquimbo, distant 60, were both destroyed. Moquehua, 120 miles off, suffered severe damage; and Arequipa was violently shaken, but with little injury. The effects extended even to the lofty peaks of Upper Peru. Tacora, 15,000 feet above the sea, had its church thrown down. When the atmosphere cleared after the calamity, that mighty range, as seen from Tacna, presented in many parts a new outline. Large masses had been detached or slid down into the valleys or

ravines, leaving many elevated peaks denuded of their most prominent features. Mr. Scott, engineer, then employed at Achozumio, about 14,500 feet high, describes the shocks there as terrific, and the noise, as if an immense mass of porcelain had, after being raised in the air, been then let fall and dashed to pieces. By his telescope, he saw the masses falling from the mountains, one of them leaving a space as large as St. Enoch's Square, Glasgow. On the 20th of January 1834, a terrible earthquake occurred in New Granada, by which the large towns of Popayan and Pasto, were entirely demolished, and many thousands perished. On the 21st of September 1834, Mr. Hamilton experienced a most severe shock, in which the movements of the earth were entirely vertical, and seemed to take place twice every second. He mentions also, the terrible earthquake on the coast of Chile, the 5th of February 1835, by which, the sea-port of Concepcion, and Talcahuano, the capital of the province, were totally destroyed. The sea then retired several times to a great distance, and returned in immense billows. It is believed, that new banks were then thrown up from its bottom, and that it was on one of these, that the *Challenger*, ship of war, a few months after, was wrecked.

MONDAY.

'On the Stratified Deposits which constitute the Northern and Central Regions of Russia,' by Mr. Murchison and M. E. de Verneuil, Membre de la Société Géologique de France.

Mr. Murchison, accompanied by M. E. de Verneuil, having just completed a tour of considerable extent in the northern and central districts of Russia, with a view to determine the general relations of the older stratified deposits of that empire, took this first public opportunity of giving a brief outline of some of the chief results at which his friend and himself had arrived, in anticipation of an extended memoir, which they purpose to prepare in the ensuing winter. The geologist who has been accustomed to the diversified outlines of physical feature which invariably characterize all those other countries of Europe in which the older sedimentary rocks exist, and has often had the utmost difficulty in working out their succession and classification, in consequence of the great disturbances and alterations to which deposits of this age have been subjected,—who has seen their frequent breaks, and sometimes even their entire reversal over limited areas, is delighted to find in so wide a portion of the earth's surface as northern Russia these strata spread in horizontal unbroken sheets; each great formation trending for distances of 1,000 miles, with few or no changes in its mineral characters or organic remains. Two great difficulties are opposed to the examination of this region: the slight altitude of the masses above the sea, which debars the chance of natural escarpments; and the vast quantity of drift or superficial detritus which obscures the fundamental rocks. To conquer these difficulties, the authors examined in succession, and as far as their time permitted, all the river banks between the longitude of St. Petersburgh and that of Archangel, which, trending from north-north-east to south-south-west, might be expected here and there to offer the evidences they required, and, having ascended the great Dwina from the White Sea to Ousting Veliki, they afterwards extended their researches to the south of Nijny Novogorod, and the edges of the province of Tambof, to determine the relations of the secondary rocks to those older deposits with which they had become familiar.

The formations succeed each other in the following ascending order:—

Silurian Rocks.—The oldest stratified deposits of Russia (those on which the metropolis, St. Petersburgh, is situated) are clays, sandstone, limestone, &c., which, from the organic remains they contain, are clearly the equivalents of the Silurian system of the British isles. The detailed order of these beds was long ago accurately given by Strangways, but at the early day when he wrote, the study of organic remains was not sufficiently advanced to enable him to determine their place in the geological series, nor to point out their relations to the superior masses. Many of the organic remains have recently been described by a native author, Pander, and also by Eichwald, and some very characteristic forms by M. de Buch, from specimens sent to him by Colonel Helmersen. These Silurian deposits occupy the islands of Oeland, Gothland, &c. in the Baltic, also the shores of Courland, and they trend thence in a broad bank from west-north-west to east-north-east, till they are lost under vast heaps of granite detritus, between the Lakes Ladoga and Onega. At the northern extremity of the latter lake, these deposits are deflected to the north, and there meet with great ridges of trappean rocks, which run from north-north-east to south-south-west. In that region all the deposits are in a highly altered state, and the limestones present few distinct traces of fossils; and the authors, having satisfied themselves that there was no chance of observing any further evidence of a descending order between such rocks and the great primary granitic chain of Scandinavia and Russian Lapland, the edges of which they coasted, afterwards confined their attention to the *ascending* order of the strata.

Old Red or Devonian System.—That the inferior strata are the true equivalents of the Silurian system was determined not only by their aspect and fossil contents, but by their passing into other overlying rocks which are completely identical with the "old red system" of the British isles, as defined by Mr. Murchison. This system is of enormous extent in Russia, ranging from the borders of Poland; Lithuania is chiefly composed of it, and Dörpat is in its centre. It thence ranges by the lakes of Ilmen, and the Waldai Hills, and is extended over an enormous region to the west-north-west, where it constitutes much of the shores of the White Sea. This vast system consists of flagstone, clays, marls, cornstones, and sandstones, the whole bearing a striking resemblance to the deposits of the same age in our isles; from which, however, they differ in containing copious salt springs, and much gypsum. It was the occurrence of so much salt and gypsum, which led previous writers to place these deposits on an equivalent with our new red system, which, from containing exclusively these minerals in our own parts of Europe, had been termed the saliferous system. That these red deposits (red and green) are, however, the true equivalents of our "old red" system, is accurately demonstrated, not only by order of superposition, but also by the many evidences of organic remains which they offer. Fishes are the distinguishing fossils of this great Russian system, and among these are species (notably the *Holoptychus nobilissimus*, Murchison) which have been described from deposits of the same age in Scotland. These fishes are in abundance, and a beautiful work in illustration of them is now preparing, by Professor Asmus, of Dörpat. The authors have traced these fish beds for many hundred miles, occupying several stages in the system.* The zoological contents of this system are also of peculiar value in illustrating the classification proposed by Messrs. Sedgwick and Murchison, or, in other words, the evidences now found in Russia leave not a possibility of doubt as to the old red and Devonian systems of rocks being identical. Terebratulæ, spiriferæ, euomphali, bellerophones, and other shells quite distinct from those of the carboniferous system, but similar to those which occur in Devonshire, Belgium, the Eifel, and other places, in deposits which have been considered by these authors to be of the age of the old red sandstone, but had never yet been found as they are shown to be in Russia, absolutely associated with the same fishes, and in rocks of the same red and green characters, in which these fishes occur in the British Isles. As, therefore, the Russian red system is recumbent on Silurian rocks, and is immediately covered by unquestionable carboniferous or mountain limestone, this question is for ever set at rest.

Carboniferous System.—In the northern and central regions of Russia, the lower or calcareous part only of the carboniferous system exists. The inferior beds consist of incoherent sandstones and bituminous shale, which sometimes contain thin beds of impure pyritous coal, and impressions of several plants well known in the coal measures of our own islands. These are overlaid by various bands of limestone, only the lower of which have some mineralogical resemblance to the mountain limestone of western Europe; other beds being undistinguishable from the magnesian limestone of England, others from a pisolite; while a third great and very prevalent band of considerable thickness, is milk-white and not more compact than the *calcaire grossier* of Paris. This white Producta limestone was observed by the authors from the neighbourhood of Moscow to beyond Archangel (and they ascertained that it ranged far into the country of the Samoedes), a district of not less than 1,000 miles. This formation has also another mineral resemblance to chalk, in being loaded with thin bands of flints, which are sometimes concretions invested with corals. It is in parts undistinguishable from the calcaire grossier of Paris, and by some observers has been called chalk. Associated with this formation, on the banks of the Dwina, about two hundred wersts above Archangel, and south of Süsskaia, are splendid bedded masses of white gypsum, which for many miles present at a little distance all the appearance of white limestone.* With these grand deposits of alabaster, inclosing occasionally large concretions, alternate two or three thin bands of limestone, in one of which the authors detected a fossil avicula, and several shells new to them. This and other peculiar fossilliferous bands near West Vaga will be described hereafter when the fossils shall have been examined. The carboniferous limestone of Russia is highly fossiliferous, and from the normal and unaltered condition of the beds the specimens are generally in an excellent state of preservation. Among them are very many well-known British species, the lower beds being distinguished by the same large *Producta hemispherica* so abundant in the Isle of Arran, and various parts of Scotland, and the white beds being loaded (among some new forms described by Fisher) with many of the species published by Prof. Phillips and by Sowerby, as well as by chætites and other characteristic corals. Owing to its mineral aspect, this rock has also been, till within the last year, much misunderstood by foreign authors, but Col. Helmersen having observed its position in the Waldai Hills, also its association with coal, and having forwarded the fossils to M. de Buch, he first gave out that it must be considered the true mountain limestone. The authors have completely confirmed this view by ascending and descending sections, and have largely extended it.

Oolite Series.—When the authors visited Russia, it was still a great problem, even with those who had just recognized the mountain limestone,† whether there was or was not a series of strata to connect the lower carboniferous beds above described, with certain rocks of the oolitic system, which have been long known to exist in the south of Russia, and some of the fossils of which were sent to England by Mr. Strangways. Certain of these beds which rest at once on the great red formation along the banks of the Volga, between Kostrowa and Nijny Novogorod, belong unquestionably to the middle oolite, as they contain ammonites and belemnites identical in species with those of the "Kelloway's rock" of Smith: other shells, found near Jelatima and Kacimof and Moscow, appear rather to resemble forms of the lias; but on this point Mr. Murchison reserves his opinion till the examination and comparison of the organic remains has taken place in London. These shales of the oolite rest at once on the white carboniferous limestone of Moscow, without the intervention of any other strata,—a fact of great theoretical interest to geologists, and of great practical importance to the Russian empire. To the former it seems to suggest the inference that equably as that great region has been elevated (so as scarcely ever to derange the perfect horizontality of the strata), the tracts in question must have undergone considerable oscillations, sufficient, first, to raise them above the sea, during that long period when the new red system was accumulated, and afterwards to depress them to admit of the deposition of shales of the oolite series. To Russia it affords a clear proof that, however productive coal fields may exist (Donetz is a fine example) in southern Russia, they are not to be looked for either in the tracts around Moscow, or in any country north of that city.

* Prof. Agassiz, having visited the meeting of the Association, confirmed the views of the authors. In the junction beds of old red which immediately underlie the carboniferous strata, a remarkable bone bed contains scales of megalichthys and of an undescribed fish which characterize our coal deposits, while the other, and far the most abundant remains, are those of Holoptychus and Coccosteus, so characteristic of the old red sandstone of Scotland.

* See note and observations on the recent memoir of M. Eugène Robert, next page.

† Colonel Helmersen.

Ferruginous Sands.—The lias is covered by ferruginous sands, containing here and there large flattened concretions of grit, which, near Moscow, are used for millstones; but never having observed fossils in this rock, the authors are unwilling to hazard an opinion regarding its age. With the exception of certain very recent tertiary deposits, to be noticed hereafter, these grits are the youngest solid strata in the northern half of the Russian empire.

Chalk.—The cretaceous system is largely developed in the south of Russia, and has been described by one of the authors in the Crimea†; on this occasion they did not extend their tour to the chalk districts.

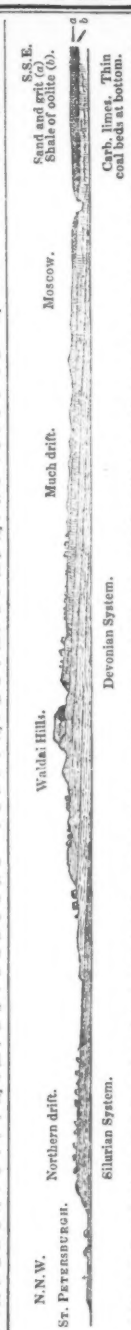
Tertiary Deposits.—A white shelly limestone, and its relations to the underlying chalk, have already been described by one of the authors† in the Crimæa. Such deposits have not yet been discovered in any of the northern or central regions of Russia.

Younger Pliocene (Pleistocene).—When the authors visited Russia, it was the general belief that all the great masses of superficial detritus, whether clays, sands, or blocks which cover so very large an area, were all referable to one epoch (Diluvium), in which the bones of the great extinct quadrupeds were also imbedded. The time to which the present journey was restricted, was not sufficient to enable them to make many distinctions of age between these different masses, but the authors have unquestionably commenced this subdivision by the discovery of beds of clay and sand on the banks of the Dwina and Volga upwards of 400 miles south of the White Sea (and therefore in the interior of Russia), which contain fifteen or sixteen species of shells, many of which still preserve their colours, and which, having been referred to Dr. Beck, of Copenhagen, have been all pronounced to be of modern species. Mr. Lyell confirms this identification, and pronounces them to be identical in species with the Uddavalla group. This discovery, in which they were assisted by Count Kayserling, who accompanied the authors in a part of their tour, is conceived to be of high geological interest, as it demonstrates that during the modern period the whole of the vast flat country of Russia was beneath the sea for a considerable time, the eastern boundary of that sea being the Ural Mountains.

Drift and Erratic Blocks.—Overspreading all the older formations, and greatly obscuring them, is a vast mass of detritus, the large granitic blocks of which have excited so much attention from the days of Pallas to the present time: this detritus, which has all been derived from the north, as well as some pliocene deposits for the first time observed by the authors in the north of Russia, forms the subject of another communication. In verbally illustrating this extensive subject, Mr. Murchison took occasion to dwell with the greatest satisfaction on the assistance and cordial co-operation which his fellow traveller and himself received from the Baron A. de Meyendorf, now executing, by order of His Imperial Majesty, a statistical survey of large parts of Russia, and who, with the most disinterested love of geology and natural history, endeavoured to make his tour correspond in many essential parts with that of the authors; and who also enriched the expedition by attaching to it two excellent naturalists—Count Kayserling and Professor Blasius, the former of whom made an excursion to the White Sea with the authors. Mr. Murchison further took this public opportunity of testifying his sincere thanks and that of his friend to the Russian authorities, who aided this geological inquiry—among whom he particularly enumerated His Excellency Baron Brunow, the Russian Envoy Extraordinary at the Court of London, the Minister of Finance, Count Cancrin, Count Nesselrode, the minister for foreign affairs, Count Alexander Strogonoff, and General Tcheffkine, the Director-General of the School of Mines of St. Petersburgh, who appointed a zealous young geologist, Lieut. Koksharof, to the expedition, without whose services the authors could not have accomplished the task which they proposed to themselves. Maps and a section (see wood-cut) illustrated the description, and selections of the characteristic fossils of each group were laid on the table.*

† M. E. de Verneuil.

* Mr. Murchison called attention to the last bulletin of the Société Géologique de France, Tom. XI. p. 310, which he had received since his arrival in Glasgow, in which Dr. Eugène Robert dilates upon the geological relations of many parts of the Russian Empire described on this occasion.



Mr. Lyell dwelt on the importance of Mr. Murchison's observations in removing many doubts as to the new arrangement of some of the British formations. Some doubts had continued to exist of the identity of the age of the beds containing fishes in Herefordshire and the north of Scotland, with those limestones containing corals and other organic remains in Devonshire, but these had been now set at rest by the observations made in Russia. We see, at the present day, different formations in the process of creation in the various seas on the surface of the globe, and these must contain distinct organic remains according to the locality: the same circumstances must have taken place at a former period, and thus the old theory of universal formations become exploded. From the almost perfect horizontality of the Russian strata, they offered the phenomena of formations existing now as they had been deposited, and undisturbed by igneous rocks. Still a general rising of the land had been proved; Baron Wrangel had observed it in the northern parts of the empire: or, if not a general rising, it could be proved that there had been an oscillation, as in some places there had been depressions. Mr. Lyell referred to his own observation of similar phenomena in Scandinavia. He instanced, also, his discovery of Arctic Sea shells at Uddavalla, 200 feet above the present sea level: also in Sweden at an elevation of 600 feet. The erratic blocks he regarded as more modern than the recent Arctic shell beds, as near Stockholm he had found blocks, at 200 feet elevation, lying on shells similar to those now existing in the Baltic—a sea of brackish water.

Mr. Craig read a paper 'On the Coal Formations of the West of Scotland.'—This communication was of considerable practical value, and of much local interest; but an intelligible abstract could not be presented to the general reader without reference to maps and sections. Mr. Craig mentioned that the coal formations of the West of Scotland occupy a space of 3,000 square miles. He alluded to some of the superficial geological features, especially to the drift, which is found only on the hills and slopes, the low grounds being quite devoid of it; this may have been caused both by denudation and by outbursts from below, and the drift seems to have come from the north-west. Under the drift and subjacent beds of clay and sand, recent marine shells are often seen, at various elevations, in one place 360 feet above the present sea level. Mr. Craig described the coal formations as divided into five groups: 1. The new red sandstone, generally conformable with the coal strata. 2. The upper coal formation, in which are shales, sandstone, fire-clay, and iron-stone, the coal being sometimes five feet in thickness; the iron-stone clayey and carboniferous, containing remains of shells and fishes, with impressions of plants. 3. The upper marine limestone group has in it sandstones—the shales contain marine fossils, in many respects similar to those found in the limestones. 4. The lower coal, in which the thickness of the beds does not generally exceed three feet. 5. The lower limestone group, the stratifications of which have not as yet been fully ascertained.

The Rev. D. Williams made a communication to the effect that it was impossible that the culm and plant rocks of Devonshire could be of the same age as the English coal field, or that the great Devonian group could be contemporaneous with any portion of the old red sandstone. The Petherwin and Landlake limestones, which were included in the lower culm measures, and which Prof. Sedgwick and Mr. Murchison had stated to "unequivocally pass into them," had not been shown to contain a single mountain lime fossil, while the aggregate result of the determination of the South Devon fossils, by Mr. Lonsdale, did not afford one coral, and only eleven carboniferous species of testacea out of sixty-two, or a proportion of about one-sixth, which he, Mr. Williams, contended did not justify placing the rocks of South Devon even in so close an approximation with the mountain limestone as the parallel of the old red sandstone. The organic remains of the Plymouth limestones, which were the highest up of any in the series, it was to be observed, were included in this analysis. More than this, Mr. Lonsdale had not adduced one fossil from the whole of South Devon, of a species identical with any of the old red sandstone system, as figured by Mr. Murchison. He must also notice another blank in the evidence: what had become of the fish? Twenty-four species of fish had been determined by M. Agassiz, and figured by Mr. Murchison; and other genera and species had since been discovered by Mr. Malcolmson, Dr. Traill, and others, over an area of upwards of 400 miles, extending from Ludlow in Shropshire, through the greater part of Scotland, to Pomona, in the Orkneys: to that great geographical sweep of country, Mr. Murchison had that morning added a large portion of Russia. Now, he must say, it was strange, if the Devonian rocks were of coeval deposition with the old red sandstone, that none of the Devonian Flora should have been drifted into Wales, and that not one of these fish should have passed over into Devon, where, as yet, not a vestige of an ichthyolite, so far as he was aware, had been detected. It was, however, contended that the Cornish killas was nothing more than a modification of the old red sandstone. On a former occasion, Mr. Williams had shown that all the great facts relating to the mineral structure of the country proved that the culm and plant rocks, after great alternations and transitions, were eventually overlaid by the slates of Cornwall; a result which his observations confirmed, for, independent of the evidences of super-position which he formerly adduced, he had discovered that, with the exception of a small interval on the south of Tavistock, the whole of Dartmoor is flanked by the lower culm measures, which dip beneath the killas and coral limestones, wherever they approach each other. In reliance on these facts, he concluded that either the culm measures cannot be the true equivalent of the English coal field, nor the killas of the old red sandstone, or the English coal field must underlie the old red sandstone.

Mr. Milne read a paper on the subject of 'Earthquakes in Scotland.'—Since the year 1788, shocks have been remarked, and have been partially registered. Three-fourths of these seem to have issued from Comrie, in Perthshire, and most of the others from the banks of Loch Ness. The district of Comrie contains mica slate, clay slate, and graywacke, with hills of granite and compact feldspar, which have elevated the other rocks, the conglomerate of the graywacke containing no pebbles of granite or feldspar; but on the former rocks is old red sandstone, containing these pebbles. There are also some remarkable greenstone dykes, which seem to run parallel to each other from sea to sea, in east and west direction, and cutting the oldest and newest strata. The

Mr. Murchison pointed out the discrepancies between the observations of M. Robert and those of M. de Verneuil and himself:—

1. M. Robert merges the limestones of the *Silurian* system in those of the *Carboniferous* era, which the authors have shown to be separated by the enormous old red or Devonian system.

2. He considers the great red formation of Russia, which the authors describe as old red, on account of its organic remains and infraposition to the carboniferous limestone, as the *Keuper*, because it contains salt and gypsum.

3. He describes as "white limestone" the splendid white *alabaster* cliffs of the Dwina, south of Süsskaia, the largest masses, probably, of this nature in Europe.

4. Having failed to notice the Younger Pliocene deposits of the Dwina, M. Robert may be induced to reconsider some of his remarks on the more recent periods, on which point and on the whole subject of the drift and erratic blocks Mr. Murchison and M. de Verneuil will give full explanation hereafter.

shocks emanated from a granite hill, or from the junction between it and clay slate, about two miles of Comrie. In October 1839, there were 66 shocks; November, 21; December, 19; January 1840, 8; February, 6; March, 13; April, 8; May, 5; July, 6; the severest being on the 23rd of October, at half-past ten P.M. It was felt as far north as Lochaber and Dingwall, and south as Carlisle and Coldstream; varying in intensity in different places. The shocks appear to come from a central point, as their direction is different at different places: at Comrie being from the north, at Dunkeld from the south-west, and at Loch Earn Head from the east. There was an upward motion at Comrie, and at other places it was oblique. There was, likewise, a diminution of intensity and sound as the distance from Comrie increased; and there was, in each place, a marked difference in the damage done to houses. The shock was more severely felt where the soil was alluvial; although, in this case, the sound was not heard, as in rocky places. Occasionally there was a fall of fine black powder, and in some places there was a sensible smell. Various explanations may be given as to the *rationale* of these shocks; but one of the readiest is, the passage of water down to some heated mass below, and its consequent conversion to steam. As bearing on this, the shocks are found to have been more frequent at the time of the year when the greater quantity of rain falls, and when the barometer is lowest. During the last fifty years, 198 shocks took place in the winter half year, and 61 in the summer. At the present time, observations are carefully taken with instruments for the purpose.

MONDAY.

SECTION E.—MEDICAL SCIENCE.

A report 'On the physiology of the Lungs and Bronchi,' by C. J. B. Williams, M.D., was read.

The author stated that he had not investigated the chemical process of respiration, and the vital effects of its interruption, but had confined his researches to the contractility and sensibility of the air-tubes and lungs. The contradictory opinions of different physiologists on this subject were adverted to: some, as Laennec, Sennert, and Bremond, attribute to these organs a self-contractile and expansive power in addition to their elastic properties; whilst others, as Haller and Müller, denied that any such vital powers were inherent in the lungs; to test experimentally the truth of these opposing statements was the chief object proposed. A series of well-planned experiments were performed, and frequently repeated, with such modifications as were well calculated to secure accuracy of result, on the lungs of various animals recently killed. The principal stimulus used was the galvanic electricity, and the amount of contraction observed on the scale of Poiseuille's hæmadynamometer, one limb of which was inserted into the trachea or bronchus. In some of the experiments various narcotic poisons were injected into the veins of the animals previously to death, and their effects on the respiration carefully noted; the instrument showing after death the extent of the diminution of the pulmonary irritability. From these experiments it was proved that the air-tubes are endowed with irritable contractility excitable by electrical, chemical, and mechanical stimuli, and probably they possess also tonic contractility. This contractility is manifest in all portions of the air-tubes; in the trachea and larger bronchi it is antagonized by the elasticity of the cartilaginous rings; it does not appear to exist in the vesicular terminations of the air-tubes. This contractility resembles that of the intestines or arteries more than that of voluntary muscles, the œsophagus, or heart, the contraction and relaxations being more gradual than those of the latter, but less tardy than those of the former. The irritability of the bronchial muscles is soon exhausted by the action of a stimulus, and may, in some degree, be restored by rest, even when the lung is removed from the body for an hour or more; but when the stimulation is long continued, as by intense irritation of the mucous membrane during life, the irritability is not restored by rest, and the tonic contractility alone remains. The contractility of the air-tubes seems to be much influenced by the mode of death. Several vegetable poisons impair or destroy this contractility. Extracts of stramonium and belladonna produced this effect most completely (their superior efficacy in spasmodic asthma has been long known); strychnia, conium, and morphia also impair this property considerably; hydrocyanic acid, on the other hand, does not in any degree impair it. The bronchial fibres seem to be more excited by direct stimulation than by any influence conveyed through the nerves of the lungs, for mechanical and galvanic irritation of the vagi nerves had no effect on them, and passing a current through the nerves to the lungs caused much less contraction than passing it through the trachea.

Dr. BUCHANNAN presented to the Section the fibrine of human blood, separated from serum, and perfectly freed from every particle of the colouring matter; he detailed his mode of preparing this constituent, which was by carefully introducing a given quantity of recently drawn blood into separated serum placed on a filter, the red particles rapidly fall to the bottom of the fluid, and the fibrine of the introduced blood is freed from its portion of serum by the filtration of this fluid through the coloured particles, or through sand spread on the bottom of the filter.

Dr. SYM gave an account of an 'Investigation of the Physiology of the organ of Hearing.'—The deductions derived were as follows: 1. The external ear protects the membrana tympani, and, at the same time, contributes to a knowledge of the direction of sounds. 2. The membrana tympani presents a large recipient surface for sonorous impulses, which draw its apex outwards. 3. The ossicula of the tympanum constitute a system of levers, by which the motions of the membrana tympani are transmitted to the fenestra ovalis, with their extent diminished, but their momentum preserved. 4. The laminæ of the cellular bones which surround the ear, convey vibrations from the larynx by means of the ossicula to the fenestra ovalis, and these have their extent increased whilst their momentum is preserved. 5. The combined effect of the difference of extent of the membrana tympani and fenestra ovalis, and the difference of range of motion of the point of the malleus and base of the stapes is to concentrate the impulses of the air, and to adapt them for being transmitted without loss, to a denser fluid. 6. The stapes is raised from the fenestra ovalis, by the impulses of the sonorous undulations. 7. The muscles of the tympanum restore the membrana tympani and the base of the stapes to their quiescent positions. 8. The fenestra rotunda permits the pressure of the atmosphere to act through the Eustachian tube upon the water of the labyrinth, so as to enable the stapes to be raised. 9. The water of the labyrinth oscillates over the auditory pulps by the alternate suction and pressure of the stapes, and this excites the sensation of hearing. 10. The extent of oscillation is regulated by the cochlea, the laminæ of which expand and contract according to the degree of friction to which they are exposed. 11. The aqueducts are diverticula, for receiving the water displaced by the expanded laminæ. 12. The petrous bone deafens the internal ear by excluding such vibrations as are not transmitted by the ossicula.

Dr. JOHN REID read a paper 'On the manner in which vital actions become suspended in Asphyxia.' The correct knowledge of this suspension, he stated, depended on the explanation of the nature of the impediment of the circulation of the blood through the lungs, and of the cause of the arrest of the sensorial functions. Three causes have been assigned to explain the first—the cessation of the mechanical movements of the chest,—the effect of venous blood on the contractility of the heart,—and the difficulty of transmitting the venous blood through the capillaries of the lungs when the chemical changes which go on there have been arrested. Dr. Reid minutely described the mode by which he conducted the experiments entered into to decide which of these is the true explanation, and from which he concluded that the impediment to the circulation through the lungs arose entirely from the cessation of the chemical changes which go forward there in a state of health, and not upon the arrestation of mechanical movements in the chest, or the impairment of the irritability of the heart by venous blood. The suspension of the sensibility in asphyxia was concluded to depend upon the accumulation of venous blood in the vessels of the brain, and not on diminished quantity of blood transmitted through these vessels.

Mr. GEORGE GLOVER read a notice of several cases in which foreign bodies had been lodged in the œsophagus. In the first case, a curtain ring of large size was pushed into the mouth of a child nine months old. Symptoms of asphyxia of an alarming character set in, but very shortly ceased; at four years of age the child died of hydrocephalus, and, on examination, the ring was found imbedded in the pharynx, bound by two bands. In the second case, a small padlock was put into the mouth, and it passed down to the pharynx, in which it was imbedded several weeks; all attempts to dislodge, or even to ascertain its exact position, were in vain; it was coughed up subsequently with a fit of vomiting. In another case, a large triangular piece of bone lodged in the upper part of the œsophagus, caused a sloughing ulcer, which proved fatal.

Dr. R. FOWLER communicated a paper on the subserviency of the fifth pair of nerves to the adjustments of the organs of sense, and of a retransmission through its nasal branch and the lenticular ganglion to the iris. 1st, On a sensation of tension felt (on approaching any metallic point, or even that of a pen, to the forehead between the eyes), probably by the muscular sense in the adductor muscles, first noticed by Bishop Berkley as the sense by which we judge of angular distance. 2nd, The contraction of the iris as often as a rod or tube of silver is passed high up a nostril, and brought in contact with a plate of zinc, under or upon the tongue. 3rd, On the reciprocal influence which the organs of sense have in exciting the adjustments of each other. 4th, That sensibility and contractility generally, are supplied, not by the brain, but by the arteries of the parts through which they are distributed.

The Secretary read a paper communicated by Mr. URE, detailing the result of his experience in cases in which he had performed the section of the adductor muscle of the eye for the cure of squint.

Mr. LONSDALE presented a preparation showing the deposit of bone in muscle and tendon, which was not derived from connexion with any bone or periosteum.

SECTION F.—STATISTICS.

Dr. COWAN read a paper 'On the Vital Statistics of Glasgow.'—He exhibited elaborate tables of its meteorology for several successive years, but it will be sufficient to state that 18° Fahrenheit, which occurred in the morning of the 21st of February, is the lowest registration of temperature for 1839, and 81° Fahrenheit, which occurred on the 17th of June, is the highest; 27.9 inches, which occurred during the great storm of the 7th of January, is the lowest range of the barometer during that year, and 30.6, which occurred on the 10th of April, is the highest. From the table of marriages, it appeared that their proportion to the population, though always high, is fluctuating, depending on the state of trade and the prices of provisions. The extremes are to be found in 1825, remarkable for prosperity, when they amounted to 1 in 83.98; and in 1837, a year of destitution, when they fell to 1 in 120.76. From the table of births, it appeared that the ratio of males to females was as 22 to 20, a proportion much above that of any country in Europe. In 1831 the proportion of still-born was 1 in 14.49, a remarkable fact, as the ordinary average is about 1 in 20. The tables of deaths gave the mean annual mortality in Glasgow from 1822 to 1830, both inclusive, as 1 in 38.275; and from 1831 to 1839 as 1 in 31.896. The deaths under five years of age, for the nine years ending in 1830, were 42.91 per cent.; and for the same period ending in 1839, they were 43.32 per cent. It also appeared that the rate of mortality generally in Glasgow had increased during the last nine years, which was attributed to the increase of population beyond the suitable means of accommodation, the fluctuations of trade, &c. The number of deaths from small-pox was very great, amounting to 406 in the year 1839. The prevalence of epidemic disease was illustrated by several tables, from which it appeared that their advance had been slow, unless when extreme destitution prevailed; "and it is only when contagious fever, that unerring index of destitution, has prevailed, and influenced the selfish fears as well as the benevolent sympathies of the inhabitants, that any active measures have been taken to alleviate the existing distress." While it is granted that destitution is the cause and effect of the prevalence of fever, few are

aware of the extent of that destitution. All who have come into contact with the mass of crime and disease in the police courts and hospitals, are unanimous in the belief that the increasing mass of misery resulting from both causes is to be ascribed to increasing destitution.

Dr. Cowan's tables were very extensive, and he was minutely questioned on the accuracy of his data, which he showed to be unexceptionable. He also exhibited a map of Glasgow, so coloured as to show the state of the districts in their relation to fever. As might be expected, disease was most rife in the wynds and closes, the filthy condition of which exceeds all power of description.

Dr. Alison then resumed the reading of the paper which he commenced on Friday, respecting the state of pauperism in Scotland. Having again directed attention to the fact, that there was virtually no provision in Scotland for the destitute poor, he proceeded to show that this system did not prevent an increase in their numbers, and did not check the deterioration of their moral character. He produced returns from Edinburgh, Dumfries, Aberdeen, St. Andrews, and some other places, from which it appeared that the proportion of destitute poor to the absolute population in the towns had increased and was increasing. A similar increase had taken place in the amount of contagious disease. He combatted the argument that Poor Laws diminished the feelings of self-dependence, and gave the following propositions, as embodying the general result of experience:—1st. That there should be a compulsory and effectual provision, defined and regulated by the law, for the relief of destitution, whether resulting from age or infirmity, or want of employment. 2nd. That this relief be so administered as to make the situation of every able-bodied pauper receiving it less eligible, on the whole, than that of an independent labourer. 3rd. That a system of strict inspection be exercised over all who receive this relief, with a view to its being always apportioned to their real wants, and so suited to their character as to favour the effect of religious and moral instruction. 4th. That in order to fulfil these conditions, particularly in the case of able-bodied persons, in the case of orphan children, in the case of old and infirm poor, or without relatives, and in the case of persons of immoral conduct, well-regulated workhouses be always at the command of those who administer this legal relief.

After a few words from Mr. Baird, describing the state of the destitute poor in the Highlands, where a penny per week is an ordinary allowance for a pauper, the discussion of Dr. Alison's paper was deferred to the ensuing day, when it was agreed that Dr. Chalmers should be heard in reply.

Mr. Joseph Bentley then read a very elaborate paper on the State of Education and Crime in England and Wales. He exhibited, in a tabular form, the proportion of persons to one school, one bookseller, one public library, one Mechanics' Institute, and one ale-house, in the several counties of England, explaining that he had collected these data while engaged in the compilation of Pigot's Directory. He had taken the criminal statistics from the parliamentary return of committals, and the amount of population from the last decennial census. He entered into a very minute comparison between the town of Dudley and the city of Worcester, from whence he inferred that education was not demonstrably a restraint on crime.

Though Mr. Bentley's paper contained many valuable materials, they were presented in a very unstatistical form, and his data were open to obvious objections. The amount of committals in any given district is often not so much a test of crime as of the efficiency of police; the mere number of schools, without any notice of the attendance of scholars or the nature of the instruction given, is equally a bad test for the state of education. When pressed upon the subject by Lord Sandon, Mr. Bentley acknowledged that he had known endowed schools where there were only two scholars. It was the general opinion of the Section, that several new elements should be taken into account before any reliance could be placed on Mr. Bentley's inferences, whilst, at the same time, the care and diligence which he had bestowed on the compilation of his tables were admitted.

Section G.—MECHANICAL SCIENCE.

SATURDAY.

Sir John Robison in the chair.

Mr. Dircks gave an account of a railway wheel with wood tyre, which was exhibited in the Museum. It was one of a set, which had been in use for two months, carrying five tons each day. The construction of the wheel will be understood by imagining an ordinary spoked wheel, but with a deep-*channelled* tyre. In this channel is inserted blocks of African oak, measuring about $4 \times 3\frac{1}{2}$ inches, prepared by filling the pores with such unctious preparations as counteract the effects of capillary attraction in regard to wet or damp. The blocks are cut so as to fit very exactly, with the grain placed vertically throughout, forming a kind of wooden tyre. There are about thirty blocks of wood round each wheel, where they are retained in their places by bolts, the two sides of the channel having corresponding holes drilled through them for this purpose; each block of wood is thus fastened by one or two bolts, which are afterwards well rivetted. After being so fitted, the wheel is put into a lathe, and turned in the ordinary manner of turning iron tyres, when it acquires all the appearance of a common railway wheel, but with an outer wooden rim, and the flange only of iron. Mr. Dircks proposes the use of either hard or soft woods, and of various chemical preparations to prevent the admission of water into the pores of the wood: he also contemplates the using of wood well compressed.

Mr. Jeffrey on a New Hydraulic Apparatus.—It comprised an improvement on the ancient endless chain of buckets, which he considers of Egyptian origin. This apparatus has hitherto never acquired the value it admits of, on account of a defect having remained in its construction, opposed to geometrical principle—the buckets which bring up the water being fixed outside instead of within the rope. The effect of this is such an acceleration of the bucket, when it is carried round the wheel at top, as causes it to overtake the water and carry much of it down again. But, by placing the buckets on the centre side of the ropes, that is, within them, the bucket when passing round the wheel, being very near the centre, is much retarded, and the momentum of the water causes it to ride out of the bucket very effectually into the trough. A peculiarity in the form of the bucket also prevents the spilling of the water in cases where the motion is very slow.

Sir J. Robison stated that, although the methods in India are rude, yet they give a greater return of work done for power applied than other methods known.—Mr. Jeffrey stated that he had tried this method on a large scale, each bucket containing $1\frac{1}{2}$ cwt. of water. A small valve at the bottom of the bucket allows the air to enter, and the bucket is thus quickly emptied.

Mr. Scott Russell's 'Additional Notice concerning the most economical and effective proportion of Engine Power to the tonnage of the hull in Steam Vessels, and more especially in those designed for long voyages.'—Large power or small power? has always been a disputed question. The early steam-boat engines had but a small power proportioned to the tonnage. The *Comet* had 25 tons burden, and only three horses power—being a proportion of power to tonnage amounting to $\frac{1}{8}$. On this subject modern practice and opinion seem to offer no guide. The East India Company have used low proportions of power to tonnage, and in this they appear to have adopted the general maxims of Southern engineers. The Government appear also to have followed the same course, but without going to the same extreme. The Clyde engineers adopt the opposite maxim, and place as much power in their vessels as can be conveniently applied. There appears at present to be a feeling in favour of a high proportion of power to tonnage. It has been found by some of the best mercantile companies that a high proportion of power to tonnage is not only better for expedition, but also more economical of fuel and of capital; and instances are frequent of an increase in the power of a steam vessel, producing a diminution in the consumption of fuel. As this question is becoming every day of greater importance, it is proper to examine it carefully. In the first place, it is known that the proportion of power must be very much increased to gain a given increase of speed;—thus, if ten horses power propel a vessel through water five miles an hour, it will require forty horses power to propel the same vessel ten miles an hour; since it will require a quadruple power to obtain a double speed, in like manner it will require a ninefold power to triple the speed. A large power of engine, it may be said, occupies much useful space which might be filled with cargo. It consumes much coal, and the speed is by no means proportioned to the expense of fuel and machinery. But this is a limited view of the subject. If time, as an element, and a very important one in the value of mercantile conveyance, be calculated, then it will be found that in many cases the effects of high speed, at any expense of fuel, will compensate for that expense. But it is not on the value of speed at the present day that we proceed in this inquiry. We are to ascertain what may be the best proportion of power to tonnage in sea-going vessels. We have seen that the lowest speed is the most economical, and that it requires expensive additions to give high velocities. But in arriving at this conclusion, we have taken only the case of smooth water: here it is obvious that the smallest power will be most economical. But it should be remembered that the great purposes of steam are generally of a different nature from the mere generation of motion through a quiescent fluid. The force of adverse winds, waves, and tides are to be overcome,—and it is the success of steam in obtaining regularity and speed, in spite of these, which constitutes its superiority. Now, if we take a simple case of one of these, we shall soon find that a higher proportion of power to tonnage may be essential not only to speed but even to economy. Suppose, a steam-boat with a small proportion of power, capable of propelling the vessel at the velocity of three miles an hour through still water, to be applied to stem a current of three miles an hour, or a proportionately strong breeze,—is it not plain that the vessel would make no headway? This extreme case of too little power shows that there is at least one proportion of power which is too small for economy of fuel. We may now proceed to investigate the question of best proportion, or the point where the attainment of high speed is accompanied by absolute saving of fuel, as compared to lower velocity. For this purpose we merely take it for granted, that the speed through the water will be nearly as the square root of the former, according to the general law of the resistance of fluids; that the resistance offered by adverse winds, &c. has been ascertained, and is determined on a particular station, that is, that it is known that on a given station, a given vessel, with a given power, makes a voyage in adverse circumstances in, suppose, double the time of her most prosperous voyage, say her prosperous voyage in fourteen, and her adverse voyage in twenty-four, days, being a retarding power of ten days out of twenty-four; we take this retardation of ten days as the measure of the retarding power of adverse weather in the given circumstances. By working out the result, we obtain the very simple rule for finding the best proportion of power to tonnage: from the square of the velocity of any given vessel in good weather, subtract the square of the velocity of the same vessel in the worst weather, divide the difference by the square of the velocity in good weather, and the quotient multiplied into double the horses' power of the said vessel, will give the power which would propel the same vessel in the same circumstances, with the smallest quantity of fuel. It further appears, that the consumption of fuel in the worst voyage, will not exceed that of the best voyage, in a greater porportion than 10 to 7—that is to say, for 70 tons of fuel burnt on a good voyage, it will not be necessary to carry more than 100 tons, in order to provide against the worst. Let us take, as example, a Transatlantic steam-ship, which has a proportion of 1 horse power to four tons of capacity; her unfavourable voyage being, between England and America, twenty-two days, and her favourable voyage fourteen days, being a comparative velocity 7 and 11.

$$\text{Then } H' = 2H\frac{v^2 - v'^2}{v^2} = 2.\ \frac{121-49}{121} = 2\ \frac{72}{121}$$

$$= \frac{12}{10} \text{ nearly.}$$

Hence the power should be increased in the ratio of 6 to 5—that is to say, the engines at present capable of exerting a power of 500 horses should have

been capable of exerting a power of 600 horses, and would, in this case, consume less fuel, as well as produce greater regularity. The following result also follows:—The vessel of less power burns 30 tons per day, performs the distance in fourteen days, consuming 420 tons of coal in fair weather. The vessel of less power burns 30 tons, performs the distance in twenty-two days, consuming 660 tons in foul weather. The vessel of greater power burns 36 tons, performs the distance in twelve and a half days, consuming 468 tons in fair weather. The vessel of greater power burns 36 tons, performs the distance in 17.5 days, consuming 630 tons in foul weather; being a consumption of 64 tons less fuel, and performing the journey in four and a half days less than the other. It is manifest, that the store of fuel carried in the vessel with less power, must, on all occasions, be equal to the greatest consumption, that is to say, at least 660 tons, whereas 630 tons will be sufficient for the vessel of greater power, and, as in all vessels for long voyages, coals carried are much more costly than the mere price of coals, or as the freight of the vessel is more costly than the fuel, coals carried are to be reckoned at least as expensive as coals burnt. Moreover, as the gain in time is 4½ out of 22, being 20 per cent., it is plain that the vessel may be calculated to do the distance oftener in a year, because, as the times of starting must be regulated not by the shorter, but by the longest period of a voyage, seventeen and a half days in the one case, stand in the place of twenty-two in the other. It appears, therefore, that, for long voyages especially, there are great advantages in point of economy, certainty, and speed to be obtained by the use of vessels of a higher power than usual; and that in a given case, the best proportion of power to tonnage may readily be determined from the rules already laid down. In regard to absolute or definite proportion, it may be stated, as the result of the best vessels, that the proportion of power to tonnage should not be greater than one horse power to two tons, nor less than one horse to three tons; the greater proportion holding in the smaller, and the less proportion of power in the greater vessel.

Mr. Fairbairn agreed, that the horse power should be increased, but that in bad weather the consumption of fuel was not so great as in fine weather.—Mr. Russell said, that practically in good weather the engines are worked expansively. There are two systems. The south engineers are afraid of using full powers; they use smaller proportions of power to tonnage, and slack the power in head winds. The north engineers always set head to wind in bad weather, and work full power; and in good weather work expansively. In steamers worked on the south system, the advantages would be as Mr. Fairbairn stated; in steamers worked on the north system, the advantages would be as he stated.—Mr. Fairbairn was of opinion, that three tons to one horse power were better than four to one.—Mr. Russell said, that it was safe to give more power than the rule gives; that on the introduction of longer and sharper vessels less power would be required.—Mr. Fairbairn observed, that the government post-office steamers, in the Mediterranean, were so bad, that the French vessels constantly pass them.

Mr. Smith made some observations 'On the Drainage of Railway Embankments and Slopes.'—Mr. Vignoles observed, that had Mr. Smith had as much experience on railways and their construction as himself, he would have known that all he had recommended had been done on various occasions, whenever the expense could be justified.

Mr. Mallet 'On the Action of Air and Water on Iron.'—Mr. Mallet stated, generally, the nature of the principal practical results obtained by him, with respect to the durability and modes of protecting cast iron, wrought iron, or steel, under various conditions, when exposed to the corroding or chemical action of air and water, whether fresh or salt. These researches have been made under the sanction of the Association, and are still in progress. Numerical results have already been obtained (*Athen.* Nos. 566–8) of the absolute and relative durabilities of about 100 different varieties or makes of cast iron and of wrought iron, in each of the following conditions as to water,—viz. In clear sea or ocean water; in foul sea water, as in the harbours of large cities; in clear river water; in foul river water; in sea water at high temperatures; in sea water at various depths; in sea water of variable saltness. The results in all these cases are given in voluminous tables, so arranged as to enable the engineer to predict with confidence the durability of a given scantling of iron of a given sort, under given circumstances. The conditions of corrosion of iron, in contact with copper, with zinc, and with tin, and with various atomic alloys of these, have been determined, and printed tables of the results distributed to the Section. Results are also given as to the relative protecting power of several paints or varnishes, to the surface of iron exposed as above. The specific gravities of all the irons experimented on, have been taken by a new method, and the increment of specific gravity due to increased depth (or head of metal) in castings determined, and also the decrement of specific gravity due to increased bulk or scantling of castings determined. These are necessary data to the foregoing investigation, and are in themselves of importance to the engineer, with reference to the ultimate cohesion of cast iron, which seems to be related, and probably is some function of the specific gravity in any given case. The experiments are now extended to wrought iron and steel; a final report is proposed, to consider the nature of the chemical changes induced on cast and wrought iron by the action of sea water, and to complete the numerical results now given, which have lately been in several instances submitted to control, or tested by the actual corrosion of castings recovered from the wrecks of the *Edgar* and *Royal George*, &c. and found strikingly to coincide.

Mr. Grimes described Dennett's Rockets for preserving lives from shipwreck, and read a letter from Capt. Denham, stating that the range of these rockets exceeded that of the mortar by 100 yards, the range of the rockets being about 350 yards, while that of the mortar was but about 250.

Dr. Wallace on Arches. The object of this paper was to exhibit a method for geometrically constructing a catenary. After explaining his method, Dr. Wallace stated that he was about to publish a set of tables for constructing the catenary, and also for suspension bridges.

Mr. Alexander gave an explanation of his Electro-Magnetic Telegraph—(*Athen.* No. 528).

Mr. Hawkins exhibited a Model of a Railway and Carriage, recently patented by Mr. Rangeley, and by him called the Safety Rotation Railway; which is an inversion of the ordinary construction, inasmuch as wheels are made to revolve on fixed bearings, placed in two parallel lines along the road; and the carriage, without wheels, is built upon a pair of running rails, carried along upon the peripheries of the train of wheels kept in revolution by steam-engines fixed at every mile or two of the road. It is intended to have the wheels three feet diameter, and three feet apart, which will give 1760 wheels on a mile. They are to be driven by a succession of endless bands, one band in every case passing around two pullies attached to every two contiguous wheels. The carriages are designed to hold forty passengers each, with their luggage; the whole, including the carriage, not to exceed five tons: the running rails always to bear on eight or ten wheels, so that no wheel shall have to support more than about ten or twelve hundred weight. The wheels, therefore, need not weigh more than half a hundred weight each, to be sufficiently strong for supporting the carriage. It is found by experiment, that three ounces suspended from the periphery of such a wheel, causes it to revolve. Any weight that sets a wheel in motion, will, if continued, cause the same to revolve with accelerated velocity, until the resistance of the atmosphere becomes equal to the accumulated force, after which, a steady speed will be kept up. It is inferred from observation, that the wheels driven with a continued force of three ounces each, would acquire a constant speed of about thirty miles an hour. It is also ascertained from experiment, that eight pounds would draw a ton weight on four three-feet wheels running on level rails, and thus that a force of forty pounds would draw the carriage. The following table is constructed from data, by which it is found that seventeen horse power of steam-engine is required to turn each mile of wheels, and two horse power to drive each carriage. The power to turn the wheels, is neither increased by additional carriages nor by acclivities; each carriage added, taking only two horse power more to carry it along upon a level; and an acclivity of 1 in 180 doubling, 1 in 90 quadrupling, and 1 in 45 octupling only the tractive force, without in any case requiring more than the seventeen horse power to turn the wheels.

Carriages Every 2 Minutes.	PASSENGERS. Every 2 Minutes.	PASSENGERS. In 12 Hours.	HORSE POWER. Per Mile in 2 Minutes. On a Level.	Up 1 in 180.	Up 1 in 90.	Up 1 in 45.
1	40	14,400	19	21	25	33
2	80	28,800	21	25	33	49
3	120	43,200	23	29	41	65
4	160	57,600	25	33	49	81
5	200	72,000	27	37	57	97

SYMBOLS OF LIFE.

The Sleeping Flower-Girl.

On a raised bank beside a sanded bay
Slumbered the wayside gatherer. On her cheek
Youth was not—nor delight, nor strength, nor health,
But something like the phantoms of all these:
Their inward light had risen, and waned, and set,
And on her face the sad reflection slept—
Slept like the moon-ray on Endymion's brow.
There was a toned vibration in the air,
And a soft ripple in the new-formed wave;
But the breeze stirred her not,—nor the wave's voice,
Even though the very flowers within her grasp
Bowed to its melody, and seemed to seek
Their once sweet dew-drops in the acrid brine.

There came a trouble to her sleep. A brief
And sudden starting shook the wild-flower leaves,
That, loosed in fear, dropt quivering from her grasp.
Away they rolled along the mossy bank,
And downward to the deep; till, drunk with tears,
All perishing they sunk—to bloom no more.
As though their loss awoke her to a sense
Of something sweet departed, up she rose,
And, bending o'er the brink, spread wide her hands
For what was past recalling; then with sighs,
Like to the wave-wind's murmur, went her way.

And, wingèd from the west, a soft Breeze came
And spoke unto the tireless ocean's ear
Words full of love and pity:—"Sacred keep,"
She cried, "Oh sea, thy portion of the gift!
Sweet to the sense, these fair but fading things,
Flowers though they seem, are human hopes and joys,
Shook by some strong convulsion from the heart,
Henceforth they dwell in us and we in them;
For we are Nature's ministers, and in her
All things are centred when the spirits of earth
Grow to their full proportion."

So she ceased,
And, with a breath, the atoms which had formed
Those seeming flowers, dispersed; and some in air,
Some to the waters, to the skies went some,
Till all were vanished: but, though lost to view,
The passionate wealth of the world-wearied spirit,
Loosed from its miser hold, yet lived the more
Disseminated wide through Nature's range.

Eleanora Louisa Montagu.

OUR WEEKLY GOSSIP.

Of home gossip scarcely a whisper has reached us, and a new book would indeed be a *rara avis*—a veritable black swan—which, however, is no longer a *rara avis*, even in England. This incidental illustration reminds us, that the (New) Eastern Zoological Gallery at the British Museum, containing the collection of birds, has been this week partly opened to the public. It contains the Passerine, Gallinaceous, and Wading birds, and the former being smaller sized, are arranged on a new plan, so that there is a light ground immediately behind each of the birds, which gives them more relief. The whole of this gallery (300 feet long) is fitted up with bronze door-frames, and large panes of plate glass, and is certainly one of the most magnificent rooms ever devoted to a zoological collection, and, at the same time, is very quiet and chaste. When the room is completed, and the one adjoining it, which will be, we believe, by the spring of next year, the British Museum will contain the most beautiful zoological gallery in Eu

rope. The collection there has lately been enriched from Russia by specimens of *antelope siaga*, and *antelope subgutterara*, two species described by Pallas, but which have never before been seen in the west of Europe.

The French Institute has lost one of its oldest members, by the death of the Marquis de Pastoret, ex-Chancellor of France, guardian since the revolution of 1830, to the children of the late Duc de Berry. M. de Pastoret had been a member since 1785, and was the last survivor of those who formed the old Academy previous to the organization of the Institute in 1795. M. de Pastoret had for some time retired from political life, but he continued to take an active part in the proceedings of the Academy, to the very close of his long and useful life.

The embellishments of the library belonging to the palace of the Chamber of Peers, are proceeding on a scale of great magnificence. In addition to the works of sculpture which we have heretofore mentioned, as forming a portion of its new ornaments, the Minister of the Interior has given a commission to M. Lescorné, for busts of Barbé-Marbois and Lainé. The painting of the Cupola has been committed to M. Eugène Delacroix; and M. Camille Roqueplan is charged with the paintings for the compartments of the south-western portion of the roof. While speaking of these applications of the arts to the decoration of the abodes of legislation, we may mention three large paintings likewise executed by French artists, commissioned by one of the American legislatures, for the embellishment of a national House of Assembly. The subjects are all taken from the wars of that country with England; the battle of York Town, fought by Washington, Rochambeau, and Lafayette, and the battle of New Orleans, in 1815, having been intrusted to M. Eugène Lami,—and the naval action on Lake Erie being from the pencil of M. Isabey and M. Morel Fatio.

M. Raoul-Rochette has received from Signor Visconti, an account of some interesting particulars of discoveries recently made in various parts of the Roman States. Near Ancona, a tomb has been found, in which the body had been laid between painted vases, with a golden crown similar to those which have been taken from Etruscan tombs. The Duchess Caëtani has found, amongst the ruins of an ancient Roman town, on the Aurelian Way, a mosaic exceedingly curious of its kind, though formed in two colours only—black and white. It is composed of nine circles, the centre one of which represents Orpheus playing on his lyre, and the eight others contain the figures of animals apparently attracted by his music. The excavations which have been resumed at Camposcala, have brought to light a small funeral ediculum with columns and a sculptured figure, of the stone of the country, and an Etruscan inscription. Signor Visconti also announces that the work of clearing the ground of the Forum of Augustus (commonly called the Forum of Nerva) is about to be undertaken, and that results of great importance are anticipated. Difficulties of many kinds have been overcome ere these important excavations could be proceeded with—a portion of the site in question being inclosed within the walls of a monastery, and a part covered with wretched habitations. But the openly expressed will of the Pope, seconded by the enlightened zeal of Cardinal Giustiniani, the head of the Apostolic Chamber, has triumphed over all obstacles. Already, the Campanile (of the Lombard period) raised on the columns of the temple of Mars the Avenger,—which had long been in a ruinous condition, and menaced the Monument of Augustus—has been demolished:—and the necessary measures for ensuring the preservation of such fragments of antiquity as may be found, have been decided on.

At a late sitting of the Academy, M. Hase made a communication respecting an inscription recently discovered in Africa, on a very fine marble, which appears to have served as the pedestal to a statue, in the theatre of the ancient Rusicada, at Philippeville. This theatre must have been magnificent. It is situated on the slope of the mountain, which rises to the west of the new town, and stretches even to the very crest, crowned to-day by the Fort-Royal. A letter from M. Aréna de Montgravier to M. Hase, gives the particulars of this last-discovered monument, and a copy of the Roman inscription, whose translation is as follows:—"To the Genius of the Colony of Rusicada, Sacred to Venus—Marcus Æmilius Bellator, Priest of Augustus and Prætor, has given ten thousand copper sestertii, new coinage, for the maintaining and adorning the theatre, on the demand of the people. He hath, at his own cost, erected two statues, representing the Genius of our Country, and of the Sacred City of Annona; and for the inauguration of these statues hath appointed a day of public games and distributions. The site given by a decree of the decurions."

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